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DEVELOPMENT OF A DANDELION FLOWER.[1]

BY PROFESSOR JOHN M. COULTER.

THERE are several reasons why the organogeny of flowers should be carefully studied, not the least of which is, that it reveals genetic relationships and could be made to read the riddle of many a puzzling affinity. This paper is based upon some very careful observations made during the present year, undertaken especially for the purpose of investigating the development of an inferior ovary, of syngenesious anthers, and of obtaining any possible evidence in reference to any of the contending theories of the morphology of the ovule. It is not the intention to discuss the various relationships indicated by the different phases in the development of the dandelion flower, though that might help determine relative rank, for this would necessitate a wider range of observation than the subject has received from any one, but simply to give an illustration of such work and to indicate what this specific case teaches with reference to the three subjects just mentioned.

Embryology assures us that the most essential characters make their appearance first, and that the order of development is from general to specific. If such a law can find its application in the development of a flower, there can be no deeper-seated distinction between groups of flowers than that of inferior or superior ovary, for it is the very first character to make its appearance. Of course the embryology of the plant begins far back of the flower, in the seed, where the development of one or two cotyledons indicates probably the first natural division of seed-bearing plants.

[1] Read in Section F of the A. A. A. S. at Minneapolis, Aug., 1883.

With this division confirmed in the structure of the stem and leaf, we approach the development of the flower as the first index of subdivisions. We are in the habit of making these subdivisions in the group of dicotyledons upon the basis of petals distinct, united or wanting; when in order of development this distinction appears immediately after that of inferior or superior ovary.

Turning now to the specific case of the dandelion, we find that the first structure which stands for each flower is a broadly obconical mass, very flat and very smooth upon its upper surface

FIG. 1.

(Fig. 1 *a*). This represents the broadened extremity of the lateral axis which is to bear the flower, and thus far the developmental path pursued by flowers with inferior and those with superior ovaries is the same. At the next step, however, which is really the first step in the development of true floral organs, the path divides, and in the case before us the apical cells cease to grow and all further axial development is completely suppressed. The peripheral cells of our obconical mass, however, continue to develop, and almost immediately five points of especially rapid growth are detected, which make the upper edge of the rising ring faintly five-lobed (Fig. 1 *b*). This ring continues to develop until the whole structure has assumed the appearance of a cup, with very thick bottom and scolloped rim (Fig. 2). This

FIG. 2.

cup continues to elongate and hence deepen, the rim becoming more and more decidedly five-lobed, when presently a shallow horizontal constriction begins to appear (Fig. 3), dividing the whole mass at first into two equal divisions and first distinguishing the corolla above from the ovary below. This line of division forms an apparent node, and from this, without and within, appear in succes-

FIG. 3.

sion all the other floral organs. The node is only an apparent one, for the floral organs do not have their real origin there, although, in the language of systematic botany, such would be called their insertion. If this insertion, however, is the real origin, the order of development is both acropetal and basipetal, for, beginning with the corolla, we have the andrœcium and gynœcium appearing in acropetal succession, and finally the calyx. The only inference is, that all four of the floral organs are blended together in the primitive ring which rises from

the original obconical mass, that they are all essentially hypogynous, and that their separate appearance at the so-called node is simply a freeing of their upper extremities. In this case the real order of development remains acropetal, and the apparent late appearance of the calyx due only to the late development of its upper portions.

Simultaneously with this constriction two other changes take place. The tips of the petals begin to turn inwards and become thickened, until finally their backs almost meet, thus furnishing a close protection about the nascent organs within (Fig. 4 *a*). Looking down upon the mouth of the corolla tube at this stage, there is a striking resemblance to a coral cell, and this likeness is intensified by the flowers being massed together upon a broad receptacle. Then for the first time can it be noted that the contiguous edges of the two inner petals are simply in contact but not united, except at the very tip, and that the tube enclosing the essential organs is a slit one. This slit extends almost to the constriction or base of the corolla, the extremely short portion of complete tube below representing what in anthesis is to become the true tube; while the slit tube investing the essential organs is to become the strap. In the bud state, therefore, it is the strap that protects the stamens for almost their entire length, strap and stamens elongating *pari passu*. But during anthesis a wonderfully rapid development of the true tube carries the strap part far above the stamens. During this rapid pushing upward, the slit begins to widen from below, the tips of the two inner petals being the last to separate, until finally the flat strap of the completely open flower appears. So rapid is this pushing upward of the true tube, that one whorl of flowers may have it fully developed while the whorl next within will have no indication of its growth.[1]

Having thus traced the corolla in its development, we will consider a second and more important change which appears simultaneously with the constriction that marks out ovary and corolla tube. It has been said that this constriction forms an apparent node at which all the parts subsequently appear. Almost as soon as the node is seen there appear within five small protuberances, which develop rapidly, become oblong, and are soon distinguished

[1] Just here is an interesting resemblance of the corolla tube in both origin and function, to the filament. For the stamens almost fully mature before the filament elongates, which is done often with great rapidity.

as the forming stamens (Fig. 4 *b*). These stamens remain perfectly distinct until quite late in the history of the bud, when they have become very much elongated. Then the edges of the anthers, coming in contact, begin to cling; the union appears to become firmer and firmer, until it takes quite a pull to separate them. The union, however, is only apparent, for careful cross-sections show close contact between incurved edges, incurved as if by being pressed firmly together, but no blending of tissues. The two contiguous epidermal layers are continuous and complete. (Fig. 5).

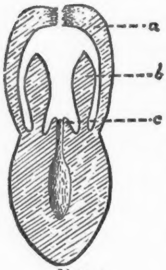

FIG. 4.

To complete the account of the development of the stamens, mention should be made of the pollen grains. As soon as the anther cells begin to elongate, exchanging their broadly oval outline for one that is narrower and finally linear, it is easy to detect within them tolerably well-defined rows of large, squarish mother-cells, about two rows in each half of the anther. As the growth proceeds the contents of these mother-cells are seen to pass through the well-known stages in the development of four pollen grains in each. The pollen grains, when first freed from the mother-cell, are roundish, but when the hairs begin to appear upon the style, they become quite angular, generally six-angled in outline. A close inspection shows that this angular appearance is due to the beginning development of the wings, which gradually lengthen, broaden and become dentate, until the mature pollen grains very closely resemble those of Cichorium, so commonly figured.


FIG. 5.

The third organ to make its appearance is the pistil. When the stamens have become oval masses and are just beginning to constrict below into short, broad filaments, just within the stamineal circle, there arise, at the so-called node, two outgrowths upon opposite sides. Below the node, within, there is yet quite a cavity, and the two outgrowths rapidly develop towards each other, overarching the cavity below, and presently meet in the center, when they resemble two lips (Fig. 4 *c*). These lips grow together, forming the style, and then elongate, soon becoming a little longer than the stamens. In the meantime the cavity below is being constricted from above downward, until the once oval cavity has become flask-shaped, and the neck of the flask closed up, leaving the cavity of the ovary some distance below the base

of the style. It is at this stage that all the parts begin to elongate rapidly, and the swelling appears at the bottom of the ovary-cell which is to become the ovule, and then also the calyx appears in the form of minute scales, which develop into the long hairs known as pappus. Thus the apparent sequence in the development of the four floral organs is corolla, andrœcium, gynœcium, calyx; but of necessity the calyx is the oldest, though the part called pappus is the last to appear. It was attempted in vain to detect in the primitive ring, or later in the wall of the ovary, any evidence of the blending of two or more distinct parts. No such indications could be found, and the inference that all four floral organs are represented in the wall of this inferior ovary rests, not so much upon the structure of the wall as upon the order of succession in the appearance of the floral organs. The idea that this primitive ring really belongs to the receptacle, and that the node, so-called for convenience, is in reality a node, would be tenable in this case but for two reasons, viz., the late appearance of the calyx and the fact that the corolla-lobes appear, not after the ring but with it, indicating that it in reality belongs to the floral organs.

It remains yet to speak of the ovule and the support it furnishes to any of the existing theories.

The ovule appears not exactly at the bottom of the ovary-cell, but a little to one side. By carefully tracing the fibro-vascular bundles, it was found that the axial bundle belonging to the pedicel of the flower ended abruptly at the bottom of the cavity of the ovary, sometimes rising into it as a small convexity, representing the real *punctum vegetationis* of the flower bud, the checking of whose growth determined the character of an inferior ovary. Just beneath this terminal point two lateral fibro-vascular bundles arise and run up each side of the carpellary wall. From one of these lateral bundles, very close to its origin, a branch arises which enters the funiculus (Fig. 6). In this case, therefore, the fibro-vascular bundle which reaches the ovule is a branch arising from a lateral outgrowth from the axial bundle. An attempt was made to determine whether the nucleus of the ovule was a terminal or lateral growth on the funiculus. Both Grigorieff and Sachs, in researches on Compositæ, and Cramer in other forms, claim that the nucleus is a lateral growth on the funiculus,

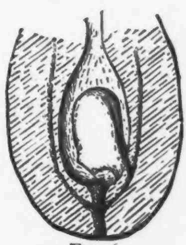

FIG. 6.

but our dandelion could not be made clearly to show it. As for the ovule itself in this case being a lateral outgrowth on the floral axis, there can be no question. At present two general views are held as to the morphology of ovules. Robert Brown, Van Tieghem, Celakovsky and Warming, sustained by Dr. Gray,[1] maintain that the "ovules are productions of and borne upon leaves," and this without exception. Bessey[2] carries this view to an extreme in classing ovules under trichomes, which they surely cannot be if we restrict trichomes to epidermal outgrowths, yet the glandular hairs of Drosera contain a fibro-vascular bundle. The ovules of Orchideæ are the only ones with which I am acquainted in which the funiculus contains no fibro-vascular bundle, and hence could be referred to trichomes, just as the sporangia of ferns.

The second view of the morphology of the ovule, the one held by Magnus, Rohrbach, Hanstein, Schmitz and sustained by Sachs,[3] is that the ovule has different morphological significance, "according to its mode of origin and position." According to this view ovules are produced either on leaves (carpellary) or the axis. To the latter origin are referred all those ovules which are strictly terminal structures of the floral axis, as those of Typhaceæ and Naiadeæ, and also those which arise as lateral appendages of the axis. To his lateral division of ovules produced on the axis, Sachs would refer those of our dandelion and all Compositæ. The two views, therefore, are in accord in certain cases, and at variance in others, and the species under consideration is of the latter kind. It would be interesting then, if possible, to determine whether the ovule of the dandelion is an outgrowth on a leaf, or an outgrowth directly from the axis. If it is the latter, it is either a branch, and its parts the homologues of leaves, which their order of development disproves, or it is itself a leaf and becomes the homologue of the other flower parts. In the case of the dandelion it seems impossible that the ovule can be considered to be produced on the axis as a lateral outgrowth. If the fibro-vascular bundle from the axis led directly into the funiculus such a view might be tenable, but it extends upwards along the carpellary wall, and sends out a branch to the funiculus. The real lateral outgrowths on the axis then, as indicated by the two lateral fibro-vascular bundles, are the two carpellary walls, which

[1] Gray's Text Book, p. 267.
[2] Bessey's Botany, p. 137.
[3] Sachs' Text-book, p. 504.

thus become leaves and the homologues of the other floral organs. It is most likely that the branch which runs up each carpellary wall corresponds to the midrib of the leaf. If so, in this case one midrib produces an ovule, while the other does not, nor do the margins of the carpellary leaves.

To sum up, in conclusion, the testimony of the dandelion:

I. The inferior ovary is produced by an arrest in the development of the floral axis, the rising in a peripheral ring of the floral organs, and the gradual arching over of the cavity thus produced, by the carpellary leaves.

II. The syngenesious anthers are united by contact and pressure, but in no sense structurally.

III. The ovule is not produced directly from the axis, but is an outgrowth from the surface (probably the midrib) of a carpellary leaf.

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NOTES ON THE CHÆTONOTUS LARUS.

BY PROFESSOR C. H. FERNALD.

IN the year 1874, I spent some time in the study of microscopic forms occurring in the fresh-water streams and ponds in and about Orono, Me. Among the animals observed was one which occurs here in considerable abundance, which I suppose to be *Chætonotus larus* Ehr.

The descriptions and figures of this animal given by Ehrenberg, Dujardin and in the third edition of the Micrographic Dictionary, are superficial and unsatisfactory. To gain a more complete insight into the structure of this organism, I spent some time in the study of its anatomy and habits.

Chætonotus larus Ehr., is very common in the fine débris over the bottom of ponds, streams and springs, as well as in decomposing vegetable matters in watering troughs, and in cisterns which have no filters. I have found it at all seasons of the year, even in midwinter in springs which were frozen over.

These animals are about $\frac{1}{225}$ of an inch long, oblong, rounded above, somewhat enlarged posteriorly, and armed on their upper surface with spines curving backward, those on the posterior part being the largest. The under surface is flat and without spines, but has four longitudinal bands of cilia. Upon the head are four colorless eyes, or what appear to be eyes, and also four clusters

of long fine hairs starting out near the eyes, but a little below them. These appear to be tactile organs, as they keep them in constant motion, apparently feeling around as they move about slowly among the débris. The posterior end of the animal is bifid, ending in two tapering caudal appendages which are quite flexible, each being composed of two segments, and with the tips slightly expanded into a disk.

In the basal portion of each caudal appendage is a gland with a duct leading from it, and opening at the end of the appendage in the center of the disk. From the movements of this animal, I conclude that the disk serves as a sucker, and also that the secretion from this gland is adhesive in its nature, for except

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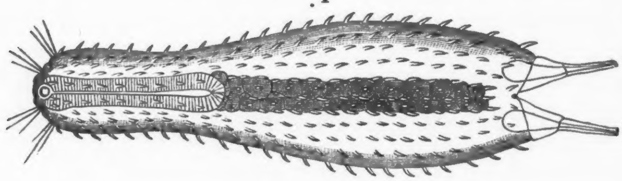

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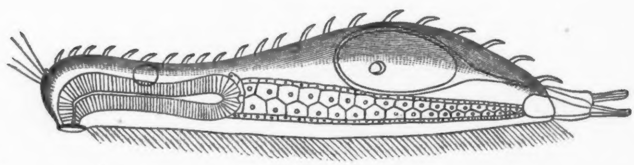

Chætonotus larus Ehr., magnified 750 diameters. 1, as seen from above; 2, as seen upon the side without the side spines.

when swimming they stick the caudal appendages to any convenient object and hold themselves in place, or swing themselves to one side or the other as they may desire.

The mouth opens on the underside, close to the anterior part of the body, through a more or less hardened ring, and the œsophagus passes up vertically about one third of the distance from the mouth to the top of the head, where it turns sharply up and back at an angle of about 45° for about the same distance, when it turns again and runs horizontally towards the posterior end for about one-third the length of the animal, when it expands into an œsophageal bulb. This opens into a straight intestine which runs through to the anus between the caudal appendages. The

œsophagus is surrounded by a thick, dense, muscular tissue of circular fibers, and the intestine is surrounded by a layer of large nucleated cells, outside of which is another layer of much smaller ones which are more difficult to make out.

Directly above the œsophagus is a globular body or cavity, but I cannot conjecture what its functions are.

In the median line, above the intestine, is situated the ovary, in which is developed but one egg at a time. This egg is very large as compared with the size of the animal itself. The nucleus is plainly visible even before the discharge of the egg from the ovary. The oviduct is easily traced to the outlet immediately above the anus.

I have often seen this animal discharge its egg, which, although it is of such a large size, does not seem to cause it any inconvenience whatever. When one is moving about slowly and feeding quietly, all at once it stops, and bending over slightly, with an apparent muscular contraction, the egg is discharged, the time occupied being not much more than one second, after which the Chætonotus instantly returns to feeding as though nothing of importance had occurred. I have watched the development of the eggs at one time and another, though not continuously, and the young when nearly ready to hatch are of the same form and structure as the adult, but doubled up within the shell. I have also seen all sizes from the egg up to the adult, and although for want of assistance I have never been able to trace the entire development of one individual through, yet I have no doubt that these animals are never parasitic, and that they do not pass through any alternation of generations.

It is exceedingly curious and interesting to see with what facility they use the caudal appendages, sticking them to the glass slide or cover in such a manner that, by careful focusing, one can see the sucker-like action of the tips of these organs while they sway about one way and the other in the water. At the same time the bands of cilia on the under side are in constant motion, causing a current of water to pass along by the mouth, carrying their food in suspension, which they readily secure. Suddenly they let go from the slide, and the action of the cilia causes them to move through the water with great rapidity, till they reach some new feeding ground, where they again anchor themselves and fish for another meal.

If a rotifer or any other moving form happens to touch even the very extremities of the tactile hairs on their heads, they instantly retreat and shoot off in some other direction.

To enable me to make out the digestive tract more clearly, I fed some on indigo and others on carmine, but it was not a success. They did not take to that sort of food kindly. I saw only one Chætonotus take in a particle of the indigo, which readily and quickly passed along the œsophagus to the bulb, when it at once appeared to become conscious of having eaten some nauseating substance. It at once let go its hold with the caudal appendages, the action of the cilia ceased, and the Chætonotus gradually doubled up a little, and then with a spasmodic effort it attempted to throw up the particle of indigo. A reverse peristaltic action of the muscles of the œsophagus took place, which was plainly visible, sending the particle up about two thirds the distance to the mouth, when the action ceased, and it gradually went back again into the bulb. This was repeated several times, after which all action ceased, and the animal died without a further struggle.

For the purpose of making a more careful study with higher powers than I could use while they were moving about so actively, I put a little cyanide of potash under the edge of the cover, and this quickly dissolving and diffusing through the water on the slide, very soon killed them without inducing any changes to interfere with a critical examination of their structure.

These studies were made before I saw a paper by Ludwig, in Zeitschrift für wiss. Zoologie, 1876, which covers the ground so fully that I then laid my drawings and notes aside, not intending to publish them. Ludwig states that these animals are hermaphrodites, the testes being situated below the anus. He does not state whether mutual or self-impregnation takes place, but if the former I ought to have observed it, as I studied so many of them and for so long a time.

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NOTES ON THE ABORIGINES OF COOPER'S CREEK, AUSTRALIA.

BY EDWARD B. SANGER.

THE tribes and dialects of Australian aborigines vary so much within short distances that it is a perplexing task to keep account of them. Systematic study, however, would probably

do much to reduce this apparent chaos to intelligible order. But they are dying out so fast that this will soon be impossible. Wherever the white man treads they disappear. They seem to have no power of adaptation whatever. Then again the customs practiced among many of them are not calculated to increase their number. Much has been told about them, but the natural history of the race is still an unwritten book.

The tribes inhabiting the Cooper's Creek region more or less resemble each other in their manners and customs. The Dieyerie (pronounced Dee-yerry) is one of the largest, and may be taken as a type of the rest. Aside from their language they can be distinguished from others in the immediate vicinity by a practice they have of knocking out the two median incisor teeth in each jaw. This habit is common, however, among other tribes in different parts of Australia. Why it is done or how the practice originated they do not seem to know themselves. At any rate it is very constantly practiced among them. In stature the men are very rarely above five feet six or seven inches. They are generally miserably thin, and have the small calves so characteristic of low races. Their skulls are dolicocephalic, very prognathous, and have immense supra-orbital ridges. The mastoid process is always large and rough. The malar bones are also very prominent. The teeth are large and strong, but are always worn down to flat surfaces on account of the sand, &c., which they eat mixed with their food. Their heads appear to be large, owing to the wavy and bushy hair, eyebrows, beard and mustache, but in reality are not so. The cranial capacity is very small, generally not over 1350 cubic centimeters. Mentally, as might be expected, they are of the very lowest caliber. They are unable to express or understand any ideas except the most simple. Indeed, their language is not capable of so doing. It has often been stated that they have a belief in a good and an evil spirit, a future life, &c. I lived in constant intercourse with the Dieyerie tribe for a year, and can absolutely affirm that unless taught so by the whites with whom they came in contact, they have no such beliefs, and, moreover, are totally incapable of forming any such ideas; nor do they possess any moral sense whatever. The tribes on the Murray river and elsewhere on the continent are of a superior grade, and very likely have such ideas, but these certainly do not. They are exceedingly timid in many respects, especially of the

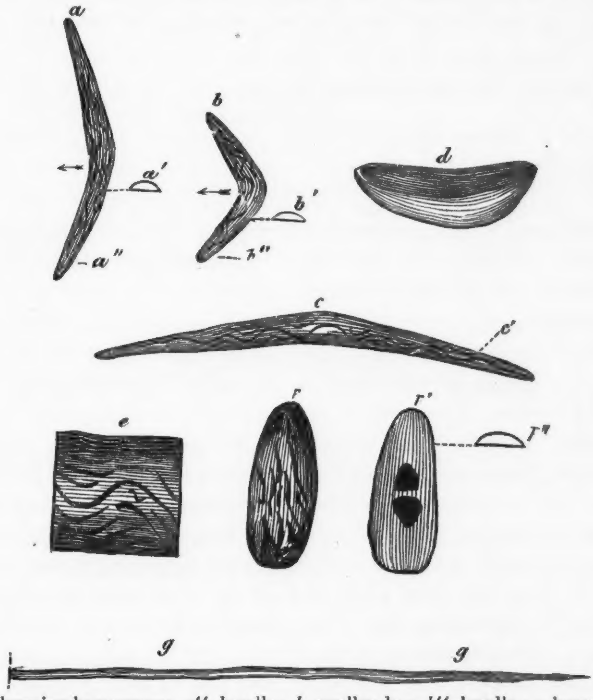
dark, and never venture away from their fire on a dark night without a firebrand.

They make fire by the friction of two sticks of wood. I have often seen them do it, and moreover have done it myself. Two sticks are taken, one of hard dry wood and tapered to a point, the other is any piece of wood that has a soft spongy or fibrous pith. A hole is cut in the side of the latter large enough to admit the point of the first. A narrow channel is also cut from the hole to the side of the stick to let the powdered pith produced by friction out. The soft stick is placed on the ground, held firmly by the feet, and the point of the hard stick placed in the hole prepared, and revolved rapidly by being rubbed through the hands by a peculiar up and down motion, without ceasing until the powdered pith begins to smolder, which it soon does, and then the solid pith commences to smoke and finally smolders. Then it is taken and whirled around in the air till there is a live coal on the end. The whole process is very simple, and any one can do it.

Their mode of living is rude to a degree. They build rude structures called "wurleys," in which they sleep. A wurley is formed by driving a few sticks in the ground inclined so that the ends meet above ground, and then heaping branches and dirt over them until covered. A small entrance hole is left on one side. The wurleys are usually about three or four feet high inside. A fire is built in front and a break-wind or *mimi* of branches erected around it, and the habitation is complete. All can be done in less than an hour. These structures are always built on some elevation near water. The natives live principally on snakes, lizards, mussels (Anodon), birds and seeds. The latter are ground between two stones by hand, by the women, into meal called "nardoo," and then baked in the ashes. The meal generally contains about twenty-five per cent of sand, and it is this which wears away their teeth. They are often short of food, and consequently many of the tribes are cannibals. The women do all the work, hunt, fish, &c. The men do nothing if they can help it. A narcotic plant, called *Pitcherrie*, is chewed by them. A quid is passed from one to another until they are tired of it, when it is plastered behind their ears to be kept till next time.

They are usually in a state of nudity, but sometimes they have a dress which consists of a string many feet in length formed of

twisted human hair, and which is wound in a coil around the waist and a few loops allowed to hang down in front. This, a bone through the nose, and mayhap a necklace of grass stems



a, throwing boomerang; *a''*, handle; *b*, smaller do.; *b''*, handle; *c*, boomerang for striking; *c'*, handle; *d*, wooden dish; *e*, part of boomerang to show carving; *f*, shield, outer side; *f'*, inside; *f''*, section; *g*, pointed end of spear.

Note.—When a boomerang is to be thrown it is grasped at *a''* with the concavity forwards and the flat side down (see section). It is thrown with an underhanded motion. These aborigines (Dieyerie) do not use the barbed throwing spears as there is no suitable wood in the vicinity to make them of. The spear figured is used for thrusting or stabbing. The boomerang consequently is the weapon of offense and defense, and they are very expert in its use. Tribes that use throwing spears are not, as a rule, very skillful with the boomerang. At any rate there are only a few in each of such tribes who are really very expert with it.

form their full-dress attire. The following is a list of all their implements, weapons, ornaments, &c.:

Wanapanyi. The polished and pointed radius of an emeu, used for piercing a hole through the nose.

Padlamookoo. The radius of the pelican (*P. conspicillatus*), worn in the nose.
Kulta Kulta. Necklace of grass stems.
Pillie. Fishing net made from the fibers of rushes.
Wanoo. Net for the hair.
Oolpooroo. Twine made from human hair and worn as a girdle.
Anpah. Twine made from the fur of animals, worn suspended from the girdle in front.
Kirrah. Boomerang.
Kirrahpinnah. Large boomerang used for striking.
Kaltie. Spear.
Narratietuah. Wooden shield.
Pirrah. Wooden dishes for water.
Tatchie. A sharp flint used for cutting flesh.

They have a few customs the object of which it is difficult to surmise. When one of them dies, the hands and feet are cut off and sent to the relations, who eat them.

Another custom still more curious has been known to be practiced among them for some time. When the males have attained an age of ten or twelve years, an operation is performed on their genital organs. The urethras are split up with a sharp flint called "tatchie" from the posterior part of the meatus at the point of the glans, along the median line on the under surface of the penis as far as the scrotum. This process has been called circumcision by the whites, but it is nothing of the sort. Among the natives it is, along with other formalities, called "making them young men." They are then allowed to have connection with the females. It is probable that it is a check on reproduction. There is not a sufficient supply of food for a large number, so this precaution is taken. It is worthy of note that in most places where game is abundant no such operation is known.

They are generally monogamists, but they have no scruples when tired of one woman in procuring another, and if the first objects she is conveniently speared. They seem to be nearly devoid of affection, and certainly have not the slightest sense of gratitude or pity. If one is hurt the others laugh. One that I had used to annoy me by continually begging for my revolver or rifle. One day I gave him an old-fashioned Colt's loaded with powder only. He immediately went up to where the others were camped and, much to their consternation, began shooting indiscriminately at them. He returned to me highly disgusted because none were shot, and when I asked why he wished to shoot them, replied that he wanted to see them "jump about."

They are very expert in tracking, and know their own country very well, but I have often completely bewildered one when in a place he had not been before. They have but little sense of direction. They know the localities of a region and thus find their way about. In a strange country they are comparatively helpless. They have a good sense of humor, and are very sensitive to ridicule. Dances are common among them, and generally celebrate some recent occurrence.

There are no chiefs, but they seem to be governed by the oldest men, who form a kind of council. Organized wars between the tribes rarely occur, but if an aborigine strays away from his own country and is found by another tribe, he is immediately slain by them.

The members of a tribe have no fixed habitation in their own region, but roam from place to place, wherever food happens to be the most plentiful. In fact, in habit, structure and mental capacity, they seem to be the lowest forms of men.

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ZOOLOGICAL GARDENS, A CRITICAL ESSAY.

BY THEODORE LINK.

THERE is a great deal more in and about zoölogical gardens, I believe, than most people are apt to imagine; indeed, a lamentable ignorance or indifference concerning the true philosophy of the subject seems to prevail, generally and individually.

Hence zoölogical gardens are probably the most conservative institutions to be met with. One may visit them, year after year, and while everything around them abounds with the healthful changes of our progressive age, they offer but few evidences of a proper spirit towards scientific advancement. It is certainly strange that some of the shining lights in natural history have never raised an indignant cry against the obvious defects and blunders thrust upon our vision at every step. Only occasionally we meet with some traces of what might be termed semi-humanitarian attempts at transcendental zoölogy; but while these efforts in the right direction are hailed with genuine satisfaction by every student of animal life, it is a pity that they should be confined to specimens of comparatively small importance and but little market value, such as deer and other native herbivores. The lions and tigers, etc., the acknowledged monarchs and nobil-

ity of the animal kingdom, are yet allowed to languish in dungeons and vaults.

Indeed, the noble beasts of the desert appeal particularly to our sympathy from their iron-grated cells, and their perpetual, uneasy walking to and fro is intensely distressing to every compassionate beholder. In briefly alluding to this sad feature of every zoölogical collection, I do not so much desire to open a new field of operation to the societies for the prevention of cruelty to animals, but rather to impress upon the managers of zoölogical gardens, at least, that the sight of cruelty, however unintentional, must necessarily detract from the pleasure and comfort of the visitors. The superficial observer may not recognize such niceties of distinction, but to the mind trained in utilitarian pursuits, they are important considerations in the attainment of the highest possible state of mental and physical comfort for all concerned.

Before proceeding any further, let us first consider the real mission of zoölogical gardens in contradistinction to menageries or "shows." I have before me the constitutions and by-laws of the different zoölogical societies in the United States, and according to the language of these documents, this mission is ostensibly "the study and dissemination of a knowledge of the natural habits of the animal kingdom." This definition does not seem to me to cover the ground, for the reason that there must first be the necessary *opportunities* before we can study; and *these* the disappointed zoölogist seeks in vain. In fact, in this respect, the zoölogical garden of to-day affords but few more advantages than any of those traveling "shows" that come to us every season. By way of example, I have passed days and weeks by many a lion's cage in European and American gardens, intent upon study and observation; but with the exception of having, by numerous sketches, impressed upon my mind the *anatomical* peculiarities of these interesting animals, I cannot say that in other respects my perseverance has been rewarded to any great extent. I have simply found that an animal, as closely confined as most of them are in zoölogical gardens, retains *none* of its *natural habits;* it only exists—a mere automaton; and even this existence is seemingly under protest. Therefore, this aforesaid "study and dissemination of a knowledge, etc.," is "a delusion and a snare."

In reviewing a few of my observations as well as some results

of statistical data which I have collected on the subject, I may simply record what hundreds of others have undoubtedly observed before me—they may not have deemed worth mentioning conditions which are so obviously the inevitable consequences of the current system of confinement; but in my opinion they furnish an array of pregnant facts for the consideration of persons financially interested in zoölogical collections, too important to pass by unnoticed. For instance, it may not matter very much for "show" purposes if most of the carnivores *are* partially blind, and painfully stiff along the spinal column, since the public at large does not easily notice these defects; but taken in evidence as symptoms of premature physical decay, and in connection with the fact that all closely confined animals last on an average not even two-thirds of their natural life,[1] these considerations gain in importance and become powerful arguments in favor of a rational reconstruction of the animals' places of abode. Now suppose a farmer discovered that his stock was getting blind, and stiff, and dying off before their time on account of the defective construction of the stables, what would he do? He would naturally remedy these defects by reconstructing his stables.

There is an impression among "animal men" that some animals will not breed in captivity. It would be strange, indeed, if they did under the existing circumstances. Yet I am convinced that it is not the sense of captivity which restrains them from propagating, but rather the incongruity between their artificial habitation and their natural habits. The black bear is a striking example. You will find him in the so-called bear pit. Why bears should invariably be kept in *pits* has never been quite satisfactorily explained to me. The pit idea was, I believe, first introduced in the Jardin des Plantes at Paris, but the savant, who originated it, died long ago without entrusting to posterity the leading thought which moved him to this achievement. Since that day all "zoölogical" bears are consigned to pits.

This brings us face to face with one of the most lamentable features of zoölogical gardens, one which has retarded their scientific and artistic development more than anything else. I mean this servile, wholesale copying after "old masters" without any apparent discrimination. Yet there is scarcely a better field for

[1] Provided that Flourens' theory on the subject of longevity is approximately applicable to the undomesticated species of mammals as well.

the exercise of all the originality and versatility of a creative genius than a zoölogical garden.

Let us now, for the sake of demonstration, examine why Mr. and Mrs. Bruin refuse to turn their pit into a nursery. The free black bear has an economical way of spending the snowy season —he hybernates. As a captive, however, he is up and about all winter, because he does not recognize the paved recesses and vaults of the conventional pit as proper places for retirement. The loss of his good long snooze seems to unsettle him completely, and lead him into disastrous irregularities in his mode of life. For instance, instead of mating during the second fortnight of the October term, as is his wont at liberty, I have known him to copulate as early as the end of July. Now, since in the natural state the periods of gestation and hybernation fall together, the logical conclusion would be that with bears a periodical suspension of animation is not only beneficial but quite necessary to the development of vigorous offspring. That captivity does not produce absolute sterility in bears, is evinced by the fact that a female in the St. Louis gardens recently miscarried about a month after conception. Such knowledge, added to some native ingenuity, should enable us to construct enclosures for bears, where, in all probability, they would breed successfully.

The landscape features of a zoölogical garden claim the full attention of the designer. The aim here must be to unite beauty with use. On the whole, I would like to see the ruling principle advocated in these pages for the care of the animals, extended to their surroundings, by imitating, as near as the climate permits, the scenic characteristics of the homes of the various specimens confined; this would be a pleasant delusion to both visitor and animal. These widely different styles of scenery should, of course, be blended into a harmonious and well-balanced composition by a very guarded and gradual transition, thus affording delightful surprises at every step.

The limits of this article do not admit of my giving a summary of the results of investigation and study on this interesting subject, or a graphic pen picture of the model zoölogical garden, such as I see it in my fancy—a very Eden of beauty and harmony, bursting upon us like a revelation, and fascinating the visitor by its innate correctness and completeness. I believe, however, I have, in a general way, indicated the road upon which

such a state of perfection could be reached. The foremost condition will be the rational construction of *enclosures*—not cages—liberal in extent, and in strict accordance with the respective habits and instincts of the animals to be confined. *Cages* cannot well be avoided by traveling menageries; in zoölogical gardens they are inexcusable.

Of the late Mr. Darwin, it is said that "he seemed by gentle persuasion to penetrate that reserve of nature which baffles smaller men." How much to be regretted that Mr. Darwin was not commissioned to reconstruct the great London "Zoo" in Regent's Park!

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THE COPPERHEAD.

BY RICHARD E. KUNZÉ, M.D.

ON the last day of August of this year, I had the good fortune to come within an unpleasantly close proximity of the head of *Ancistrodon contortrix* without being bitten by that reptile, and from the peculiar circumstances connected with it, I am led to propound these questions:

1. Does *Ancistrodon contortrix* ever strike at an enemy without being coiled up in that characteristic attitude of *Crotalus durissus*, previous to the latter's giving his fatal blow and while sounding his rattle?

2. Does *A. contortrix* ever feign death?

The reason why I am prompted to ask these questions is, because the only other specimen of the copperhead I ever met during a period of twenty-nine years of collecting, was one I encountered in a coiled up and striking attitude, as I supposed, and under circumstances which I will further on relate. Yet I am fully aware that the rattlesnake, when striking in order to seek food, does not first coil himself nor even sound his warning note previous to striking the fatal blow. These observations I have verified on a caged specimen, as reported in Nos. 21 and 22 of Vol. 1 of *Science News* in the year 1879.

On the day mentioned I collected a quantity of *Monarda punctata* in New Jersey, a quarter of a mile from the depot of Matawan, in Monmouth county. The field where I obtained the horsemint, of which I use considerable for medicine, was a narrow strip of fallow land in the same enclosure with a cornfield to

the west, an extensive swamp to the east, and bounded by the New York and Long Branch R. R. on the north, near the junction of the Freehold and New York R. R. This uncultivated lot was overgrown with many plants of Monarda, *Apocynum cannabinum*, a few Millefoliums, Asters, and much more of *Cenchrus tribuloides*, the annoying hedgehog-grass. Here and there in the sandy ground were a few *Rubus canadensis* and *Cassia chamæcrista*, which made up the vegetation of the spot, not covering more than half an acre all told. It was gently sloping towards the swamp, the steep bank of which, nearly twenty-five feet high, was covered with bushes and a rank undergrowth of weeds and briars, a fit lurking place for reptiles, and more so perhaps because on the side nearest the railroad trestle a number of springs poured their pure water down over the shady declivity, making it a resort for birds and other animals.

Having missed an earlier train, I did not arrive on the ground until after 4 P. M., when the sun was fast receding in the west. I took a hasty stroll over the field to better understand where to commence work, and in so doing walked directly over or past the locality where I afterward met the copperhead without having observed anything unusual. Having had a kind of presentiment all the morning and ever after, that I might possibly come across an Ancistrodon, which I did not have the slightest wish to do, I could not help examining all the ground most carefully before me, and so much so that it more than annoyed me during the short time left for work.

While thus engaged cutting with my right hand the Monarda, which I carried in the left, and while slowly moving in the direction of the cornfield, with my back to the swamp and the rays of the sun lighting up the ground before me, I instinctively drew back a step on the discovery of a triangular-looking object before me close to the ground, the other end of which was partly hidden by intervening plants. Taking a hasty second look, I noticed that it was the head of a serpent with the body stretched in an opposite direction, and to all appearance dead or motionless. With the glare of the sun in my face and an otherwise defective eyesight, I could not, from where I stood, fully observe the condition of the reptile's eyes, so as to assure me whether he was dead or alive. Taking another step or two south of where I previously stood, I was enabled to take a lateral view of the ophidian,

and at a glance discovered an unmistakable light issuing forth from the latter's eyes, which warned me to be on my guard.

While I must have impeded the serpent's progress, gliding as he did toward the embankment of the swamp, and not ten feet from the edge of it when first noticed, the snake must have been as much surprised at my intrusion upon his siesta ground, as I was. It seems as if he had suddenly discovered my presence and was fully aware of my peaceful intentions, when I found myself face to face with him at a distance of only fifteen to eighteen inches from between his wicked-looking eyes and my hand. He must have come to a sudden halt with the form of his body still indicating the previous gliding motion. The head and neck was pressed closely to the ground, and the former unusually flat.

After stepping to one side I took him to be a yellow rattler, so very deceptive were his colors, but a glance at his tail revealed the absence of the horny appendage. He appeared not to be more than two feet in length, and was as thick in the middle third of his body as a rattlesnake of twice that length, in fact, fully as broad as my wrist. The appearance of the entire body was that of complete relaxation, and presented an unusually broad surface of body, the same as that I have often witnessed in rattlesnakes I formerly had while asleep. Even the dorsal line was raised much above the sides, which gave the back a triangular shape, much the same as in Crotalus.

It was out of the question that it could be *Heterodon platyrhinos*, because the blowing viper has a thicker neck and tail, and is differently marked and colored, whereas this serpent had a very constricted neck close to the head, and a more slender caudal extremity; nor would it hiss or blow, which is so characteristic of Heterodon.

I next thought that it might be *Pituophis melanoleucus*, when it occurred to me that a pine snake of such a thickness should be at least thrice as long if not more so, and then the very flat, triangular head precluded such a possibility as that, not to speak of the color, which the specific name would indicate.

And it was not a species of Tropidonotus either, although at a distance some of the duskier specimens might be taken for a copperhead. But we never find water snakes very far from their element. Many years ago, when collecting many Chelonians for my brothers in Germany, I frequently started up unusually fine speci-

mens of Tropidonotus beside their element. But as every one knows, their movements are far from sluggish.

Under exciting circumstances one cannot take in the whole situation at once. The ground work of the flanks of my ophidian was of a beautiful clear yellow, intermediate between a lemon and orange shade, much brighter than a cream-yellow, and which prevented me from determining him at first as an *Ancistrodon contortrix.* The specimens I had seen, dead or alive, were all more or less of a dusky color or dirty gray, where this one was of a yellow hue. The bright, chestnut-colored, inverted Y-shaped blotches on the sides seemed to be confluent on the dorsal line with those from the other side, giving the back an appearance of continuous bands. It was these bands which at the first glance made me think that I had a yellow Crotalus before me, although I very much doubt whether Monmouth county at present can produce such a variety. Perhaps Professor S. Lockwood can inform us whether such ophidians still inhabit that part of New Jersey.

It presented anything but the "graceful lines" in which Hogarth describes the much-abused ophidian. The only graceful portion of this specimen consisted in a few inches of a slender and cylindrical caudal extremity. That portion of the body from the region of the anus to within a few inches of the constricted part of the neck, was disproportionally thick. The large flat, triangular head with its sunken features, so suggestive of the hippocratic face of a moribund individual, was anything but assuring; and its wicked-looking eye was suggestive of "touch me if you dare."

However, in point of color he was a rare beauty; the bright and clean-looking scales reflected the sunlight in a degree second only to a varnished leather belt. The blotches on the dorsum and sides in shade of color resembled that of a horse-chestnut. His snakeship looked as if he had just donned a new suit, so bright and well defined were the colors and markings. In fact, shortly thereafter I found an ophidian "overall," and not very far from where I encountered him. I think that the fashionable "skin-tight trousers" belonged to my Ancistrodon. I threw the skin over an Indian hemp plant, calculating to take it home with me for future identification, when on looking for it afterwards I found it was gone. A light breeze might have lifted and carried it off.

I now came to the conclusion to capture that serpent either dead or alive. In looking around I could not see a stone as large as a hickory-nut, nor a stick nearer than forty or fifty feet distant. I cut one from an aspen sapling leaving it notched at the end. The spot where I left the ophidian, apparently as motionless as ever, was marked by a lot of cut horsemint, and when I returned the reptile had given me the slip, and without any doubt resumed his interrupted journey toward the swamp.

I spent some time in looking for him on the field, and even started up another colubrine specimen resembling *Ophibolus clericus* B. & G. (syn. *Coluber eximius* Holbr.), over three feet long, which hastily glided down the bank of the all-protecting swamp. The latter would prove an El Dorado to the herpetologist.

It being near even-tide I cautiously resumed my work beside that swamp, but could not help thinking of Mr. Whittier's lines addressed to the Amphisbæna, that

"Far away in the twilight time
Of every people in every clime,
Dragons and griffins and monsters dire,
Born of water and air and fire,
Or nursed like the Python in the mud
And ooze of the old Deucalion flood,
Crawl and wriggle and foam with rage,
Through dusk, tradition and ballad age.
* * * * * *
* * * * * *"

During the remainder of the day and evening I could think of nothing else but that Ancistrodon. How close it permitted me to approach him without showing any signs to resent my familiarity, although the latter was unintentional on my part!

It is barely possible that I lacked just a few inches too far off for his aim, and thereby providentially escaped being struck by his deadly fangs. The effect of this episode on my mind is better understood by the following dream, which disturbed my rest that night:

I imagined myself beside a large meadow in a ducal park, where my father had been horticulturist-in-chief, and where in early youth we children used to play. All at once two great serpents raised their heads above the grass and with their bodies reaching across the entire field, commenced to thrash the green sward. Finally the giant ophidians grew larger and still larger, until they appeared to vie in size with the sea-serpents of the

New York Sun. This was too much of a strain on the exhausted condition of the dreamer, and making, as I suppose, a frantic effort at escape, I awoke to find myself in bed and in a not very rested condition of either body or mind. And it was not to be wondered at either, after knowing

> "Of that sea-snake, tremendous curled,
> Whose monstrous circle girds the world."

Nearly fifteen years ago, on or about the middle of October, I went with a friend to a swamp east of Yonkers, in Westchester county, N. Y., for the purpose of enjoying a day's shooting. On the edge of the swamp we flushed a covey of quail, which scattered in the open on the hillside beyond. My setter soon took up the scent again and presently came to a "dead point" in front of a little cedar tree. As soon as we came up, I ordered Major to "go on" and flush the game, which he refused to do, nor did he obey any future commands to the same effect. Telling my companion to advance on one side of the dog, I passed around the other side of the cedar, where to my horror I discovered a copperhead all coiled up, with his head elevated, and ready to give my dog a warm reception. I shouted "heel up" to the dog but he refused to stir, and finally walked back and seizing Major by the collar dragged him out of the way of harm. My friend then stepped up and killed the serpent with a charge of shot. It measured nearly twenty-four inches, and was of rather a dusky color throughout. The specimen was badly mutilated, and first removing its poison fangs, I left it on the field. My setter was blind in one eye, and it made me all the more apprehensive for his safety.

Twenty years ago I received from a friend living on the banks of the Hudson, between Spuyten Duyvil and Riverdale, in Westchester county, a fine specimen of a copperhead, which had been killed close to the door of his residence, built on terraced ground, and adjoining the property of the late Judge Whiting.

He and another friend having but just returned from a shooting trip on the hill, were seated under a grape arbor which covered one of the terraces running parallel with the rear entrance of the mansion. Their fowling-pieces stood within easy reach behind the open door. Of a sudden a rustling sound was heard in the leaves just back of their seat, and a moment later a frightened toad hopped down the embankment, when to their surprise he

was followed by an *Ancistrodon contortrix*, which, on reaching the terrace, was almost ready to pounce upon his intended victim. It was but the work of a moment for one of the astounded observers to draw the ramrod from a gun, with which he killed the serpent, giving the batrachian a chance to escape.

It was a remarkably fine specimen of a serpent, measuring, I believe, thirty-two or thirty-three inches in length, and but little lacerated by the blow from the ramrod. I afterward presented it to the Museum of Natural History of this city (New York). The markings of this reptile were well defined, and the blotches of a good chestnut color throughout. The ground color was rather of a light grayish-brown, and far from yellow.

Several other specimens of living *A. contortrix*, which I have seen on exhibition in different places of this city, were all free from that yellow color which distinguished the ophidian I met so unpleasantly close at Matawan, N. J.

It is stated in "Ophidians," by Dr. S. B. Higgins, that the copperhead invariably bites low, in contradistinction to the Crotalus, inflicting a wound in the region of the ankle joint both in man and animals. If this be so, then the act of coiling previous to striking at a foe could be dispensed with. In Higgins' work, which principally treats of the poisons and their galls as antidotes against the bites of all venomous ophidians, the copperhead is designated as *Ancistrodon contortrix* B. &. G.

As I find so little published in scientific literature about the habits of the copperhead, I must have recourse to some accounts clipped from newspapers. They illustrate one point in question, and which relates to the part wounded when human beings have been the victims. Another fact learned from the same source refers to the number of young of the copperhead, which compares quite favorably with statements regarding other serpents made in the volumes of the AMERICAN NATURALIST, by various informants.

From the New York Sun (Aug. 29, 1880).—In Reading, Pa., a copperhead snake, thirty-seven inches long, was found to contain eighty-eight young snakes, all alive, and four to six inches in length, when it was killed by James F. Hinkle.

From the New York Sun (Oct. 24, 1880).—Lewis C. Wilson, of Washingtonborough, Pa., killed a large copperhead snake which, when opened, was found to contain sixty young ones.

From the Oil City Derrick—New York Sun (July 13, 1879).—Wednesday evening a little boy named Mishler, whose parents

reside in the lower end of the Third ward, in what is known as Irishtown, was bitten by a copperhead snake. He was playing at the corner of the house when bitten, and ran to his mother at once. He told that a snake had bitten him, and then jumped over his head. The lad showed a small red spot on his ankle where he said the bite was. The mother thought it was only a bee sting, and paid no attention to it until the wound began to swell. Then the doctor was sent for, who pronounced it a snake bite, and gave remedies at once. The boy was then carried to where he said he had been bitten, when the snake was found there coiled about a burdock plant. He was an ugly-looking reptile, and was quickly despatched with an axe. The boy was doing quite well last night, and there are hopes of his recovery.

From the New York Sun (Aug. 29, 1880).— While picking blackberries on the Mine Hill mountains, Mary O'Brien, of Black valley, Pa., felt something rubbing against one of her stockings. She continued picking berries, and next felt a sharp and sudden pain in that limb. Springing out from the bushes she found a copperhead, over a yard in length, coiled about her leg, and without an instant's loss of self control, she took the snake by the tail, and after unwrapping it dashed it to the earth and beat it to death with a club.

From the Philadelphia Times (Reading, Aug. 21, 1879).—At the camp meeting of the Evangelical Association near Sinking Springs, this county, Mrs. Mary Deitzel, aged sixty-five, a sister of the presiding elder, Rev. J. M. Saylor, was so badly bitten by a copperhead snake this morning, that she was brought to Reading in an unconscious condition. * * * * Mrs. Deitzel desired to prepare an early breakfast. She reached down under the stove to get some kindling wood that had been placed there to dry. When her left hand had been withdrawn from under the stove, Mrs. Deitzel felt a slight pain. She saw a drop of blood on the knuckle of the first finger of the left hand. She thought that probably a splinter had pricked her, or that a wood mosquito or a spider had stung her. As her hand and arm commenced swelling and getting stiff, she became alarmed. A search was made. Under the stove, in a coil, was a poisonous copperhead snake. The finders instantly despatched it. It was sixteen inches in length, and was quite thick. It was brown on top and flesh-colored underneath.

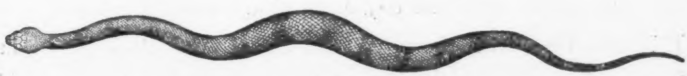
From the New York Sun (Oct. 24, 1880).—A copperhead snake bit Mrs. Henry Overart, of Concord, N. C., on the little finger of her left hand, and she died before medical aid reached her.

I have been informed by another physician, that two years ago a surveyor employed by the West Shore Railroad, while at work near Highland, Ulster county, N. Y., was bitten in the ankle by a

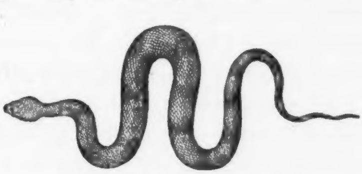
copperhead. It was with the utmost care and exertion that his life was saved.

Other instances of "copperhead bites" I could cite from the "snake columns" of the *New York Sun*, where death even resulted in consequence of the injury received. But the locality of the bite not being mentioned, it would not serve the purpose of showing where such injuries are generally inflicted.

It has been said by Mr. J. A. Graves, a veteran showman, who may be found at Bunnell's Museum, of this city, that a snake stretched out in a nearly straight line could not bite. As, for instance, in such a position as this:



And if a copperhead should place himself in this shape,



all a man would have to do, would be to throw him out of position with his cane, and then he could not bite him.

The copperhead I found at Matawan, N. J., did not place himself in such an aggressive attitude, if it may be so called. The head and tail were in one line, as it were, with the intermediate parts lying in easy curves, just as we observe it in the gliding movements of such a serpent.

Since the foregoing was written I met a brother physician, who was born and raised in Dutchess county, N. Y., and he told me that in his boyhood he frequently found and teased the copperhead or pilot, so-called, only a few miles south of Poughkeepsie, and what is now known as Milton Ferry, on the Hudson River Railroad. A little above that place, and what was known as Spachen Kill, a creek connecting with Gill's millpond, was a swampy neighborhood infested with copperheads. They were so plentiful that many of the laborers employed in building the Hudson River R. R. at that place were bitten by those reptiles,

and a number of the men died. A house standing in the vicinity was so much troubled with those and other snakes, who sought refuge in the cellar, that it was burned down and allowed to remain in ruins, no one caring to live there. Dr. C. H. Yelvington told me that the copperhead *never* bites when coiled up. But he will throw the middle of his body into long, almost rectangular curves, as the above drawing indicates, and with his head and an inch or so of the neck slightly elevated above the ground, is ready to defend himself.

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EXPERIMENTS WITH THE ANTENNÆ OF INSECTS.

BY C. J. A. PORTER.

IN accordance with the suggestion of Dr. A. S. Packard, Jr., in an article published by him in the NATURALIST, Vol. XI, page 418, and also in pursuance of the plan hinted at by Mr. L. Trouvelot (AMER. NATURALIST, Vol. XI, page 193), I made, during the season of 1878, some pretty extensive experiments on the antennæ of insects with the view of finding out, if possible, what is the function, or functions if there may be several, of this part of the insect economy. I experimented with a great many individuals, and these of many different species of insects, and give below an account of a few of these experiments, together with the conclusions I have ventured to draw from the whole. Not that I would say the experiments are in any way exhaustive, or that the conclusions drawn are altogether correct, but I present them that I may do something to excite others, who may be more competent, to turn their attention and spare moments to this subject, which all will no doubt agree it is certainly time to investigate more freely than it has been heretofore. I have selected from my notes such experiments as seem best to represent the whole, and it will be noticed by those who have read the above-mentioned papers, that in some respects our results differ, while in most instances they agree. The differences, however, may be due to variations of experiment.

1. I found a large humble-bee on a clover stalk a few rods from my room; I caught it by throwing my handkerchief over it, and then carrying it home, I placed it in a glass fruit-can in order to let it recover if in any way it might have been injured by the capture or carrying. When it seemed to have been in sufficient

time, I put it out on the table and let it run around and fly about till I was satisfied it was all right. I then cut off one of the antennæ, cutting away about two-thirds of it. I noticed that it immediately let the stump drop, but otherwise it did not seem to care *at first.* But I soon found that it began to feel dizzy and to fly very unsteadily, and when taken into the middle of the room and let fly toward the window would not always strike it, but would hit the wall often several feet to one side or the other. I then cut off the other antenna in the same way. It soon began to grow weaker and weaker very rapidly and to fly very laboriously, but was still able for some moments after to reach the light of the window, though in a very random manner. On reaching the window for the last time, it buzzed up and down the pane a few times but soon ceased and began to walk back and forth on the sill in a very restless manner, stopping every few inches to rub the stumps of its antennæ with its fore feet and seeming to be in great pain. Soon it became too weak to walk except with apparently great exertion. Finally it crept into a small hole between the sill and the plastering of the wall. On being driven out again it crept under a small stone lying on the sill, and seemed to be trying to get away from the pain, reminding me of the motions of an ox which has been struck a hard blow on the horn. When taken from the window again it did not try to find its way back or even to fly, but crawled feebly over the floor, growing weaker all the time, and if thrown into the air would buzz and fall at once like so much wood. But all this time I noticed its power of direction, as far as I could see, was not at all impaired, as far at least as walking was concerned, and that its sight was as good as ever; for whenever I put my hand, or any moving body, near it, say three feet, it would immediately roll over on one side, tuck the head under the body as if to protect the mutilated antennæ, and at the same time throw up its legs as if to ward off my hand. At length it crawled up the table leg and sat down on the first bead of the leg, some six inches from the floor, and tucking the head under as far as possible, seemed to give up in despair. In about ten minutes I got some sugar for it, but it was so far gone already that when I put the sugar to its mouth I came very near knocking it off the table leg with the straw on which I had the sugar. It took no notice of it except to push it away and wipe off with its feet what I put

on the stumps of the antennæ, and then draw its head under again. It soon crawled further up the table leg to the second bead, where it sat till the next morning. As soon as I came near it the next morning it threw up its feet again to ward me off even before I touched it. It sat in the same position for fourteen hours in all, and at the end of that time I saw it on the floor, but do not know how it got down—whether it fell or came down of itself. It sat in one place on the floor for some time, but at length began to crawl, or rather to drag itself across the room, carrying the antennæ up high as if sore. When it came to the sun on the floor through the window, it stopped, turned its head toward the sun and sat down again as before, and in this position I found it three-fourths of an hour after apparently *dead.* But it was *not* dead. I picked it up and pulled out one of the antennæ to examine it with a microscope. As I drew it, it came out by the roots as it were, leaving a considerable hole in the side of the head. I left the body on the table where it lay perhaps an hour, and I had almost forgotten it when I was surprised by my sister asking me, " When are you going to kill that poor bee and put it out of its misery?" On going back I found it had come to life again and was crawling over the floor as if in great misery, pausing now and then to rub its mutilated head with its fore feet. I thought it was time to kill it, and did so. I think it had fainted on account of the pain.

2. I found on my window, where it had been for several hours, a smaller humble-bee; I think, as I did not preserve it, one of the kind which nest in the cornice of buildings, &c. It would not notice anything, bad or good, which I put on its antennæ; but when I cut off one, it seemed to hurt it much and make it fly very much at random from place to place. When I cut off the other it lost all ambition and strength, and did not try to sting me, though I must say I gave it only a moderate chance, as I handled its abdomen rather carefully. It was soon too weak to bear the weight of its own body or to stand upright, but would tumble over on its side or back and not move till disturbed. I laid it on its back and walked on an errand a mile and a half from home; when I returned I found it had not moved. I then killed it.

But it might be well to say here that all humble-bees are not so affected; some hardly seem to know they have antennæ at all,

not even by the loss of them; others again get very sick, and then after awhile recover.

3. On the same day I caught a long fly-like insect on my window. Its antennæ seemed very tender, even to the slightest touch of a straw. When one was cut off it did not seem to hurt it much. But when I put some pepper-sauce on the other it contracted it very much and ran around as if it were crazy. Once or twice it tried to clean it off with the mouth, but seeming to get a taste of the sauce, it did not use its mouth so again, but took its feet to it, and at the same time tried every few steps to clean both mouth and antennæ by rubbing them on the window sill. The stump was not so much affected by the sauce, though it noticed it also. I might remark here that *many* grasshoppers act in much the same way under similar treatment.

4. I caught five common crickets with the intention, at first, of trying to find out whether the power of direction resides in the antennæ. Of one I cut off the right antenna, of one the left and of two both, leaving the other two whole. I then turned all five out on the floor. The deantennized ones did not notice it at first, but after a while they drew the remaining stumps several times through the mouth and then let them alone. I could find no difference of movement among them, but all seemed as lively as crickets generally are. Failing to find anything like a sense of direction, I caught them again to try if I could find in the antennæ anything like a sense of hearing. Among the other noises I made, I got a large jews-harp and played on it with all my might. But they took no notice of it, at least as far as the antennæ were concerned, but sat in contemptuous silence, though I executed for them, to the best of my ability, many martial airs of the land with now and then a love song or a waltz. And let me say just here that another cricket whose antennæ I had cut away, and which I placed in the kitchen, "sang" all summer long. And also that of all the experiments I have made, I have not been able to find anything like a sense of hearing. Antennæ all seem to be deaf. Next, with these same crickets, I experimented to find a sense of taste in the antennæ. Instead of using things which might taste well to them, I used some table mustard and some pepper-sauce. Putting some of the mustard on the end of a straw I found that when I touched it on the antennæ they would remove them immediately. The stumps were not quite so

sensitive as whole antennæ, as they did not clean it off of them as off the antennæ. The pepper-sauce was, if anything, more distasteful than the mustard (if it might be called taste).

I experimented with crickets many times after with the same results.

5. On June 11th I caught one of the large black and gold-spotted beetles common in wheat fields. I gave him, *via* the antennæ, all the good and bad tasting things I could get hold of, but he cared not a bit. Nor did he care any more when I cut them off, and though I kept him a day after, he was as full of life at the end of that time as before. This may be taken as a fair representative of *most* beetles. They are a very don't-care set, at least as to their antennæ.

6. Contrast with the last, however, the following case: July 9th I caught one of those Coleoptera which so many people mistake for butterflies on account of the way they fly. It was a triangular insect with yellow and black bands across the wings. It seemed to have nearly all its life concentrated in its antennæ, so that whenever I even pinched one of them a little, it seemed to paralyze the insect. When I cut them off it walked a few inches and then fell, as I thought, dead. I noticed that from the wounds of the head there came out a fluid which had a very high power of reflecting light. I placed it under the microscope, and was much surprised to find that, although when it first came out it reflected so much light as to be painful to the eye, it soon changed color and ceased to reflect. In order to examine it more, I ran several pin holes through the body and then concentrated enough light on it to scorch the hand, when to my greater surprise it began to crawl away from the heat. It had been in a state of insensibility for at least fifteen minutes. It revived very slowly, but was able to drag itself along, when I killed it.

7. This one has reference to smell, and was one of those beautiful brown and red and white and variegated butterflies so common most of the summer. Having split one end of a long broom-straw, I placed in the cleft a piece of gum camphor, then taking the wings of the butterfly between the thumb and finger of one hand, I presented to its antennæ the straw, first one end and then the other. It did not notice either end of the straw as long as I moved it about close to the antennæ; but whenever I

put the camphor end near to its head and mouth-parts, it would begin to struggle with all its might as if to get away from the fumes of the camphor; thus showing not only that it disliked the smell of camphor, but also that it did not smell with its antennæ. After experiments have shown the same thing of other insects.

I will add here that this butterfly (as also many other species) was little or not at all affected by deantennization, but flew about the windows for many hours afterward, and when finally turned out of the door, flew away as happy as ever.

8. This case represents many others which seem to me to point to a sense residing in the antennæ, and which out of respect to old custom and belief I call feeling, for want of a better name. I found a young grasshopper-like insect sitting on the edge of a bucket of water. I found that on putting my finger to one side or the other of its head, it would throw the antennæ, which was two or three times the length of the body, on that side, towards my finger, and if it could reach it would touch it, though very slightly, as if to feel for it. If I moved my finger to the other side, it used the other antennæ in the same way, or if I put my finger where it could use both at the same time, as in front, or above, or behind it, it did so. I do not wish, however, to be understood to say that the sense of touch lies in the antennæ.

9. Add, lastly, to these the following: Toward the latter end of summer an old gentleman sent me for experiment a large specimen of the common crab. I placed it in a bucket of clear water and then found that whenever I put anything anywhere near it, it would throw out its antennæ, on one side or the other, and touch it slightly, much as the one last given. When left to itself it would invariably sit with the antennæ in a horizontal position and at right angles with the line of the body. But when I cut off one it instantly pointed the stump forwards and upwards while it held the other in the same position as before. Otherwise it was not affected by the mutilation, but used the stumps as before. But when I smeared both well with pepper-sauce it would not even feel with them till the water had cleaned them off. It lived many days after deantennization, and seemed to thrive as well as ever.

Conclusions.—From all the experiments I have made, of which

the above may be taken as representative, I have been led to make the following conclusions:

1st. The antennæ are not the organ of any one or of any combination of what we call the five senses—hearing, seeing, smelling, touching, tasting. With respect to these the only sense which one would be at all likely to question, would be the last, taste. It is true that insects often seem to be able, in some way or other, to tell the difference between good and bad tasting things when such things are brought in contact with the antennæ. But I do not think we have any more reason for saying that insects taste with their antennæ because they dislike to have such things as pepper-sauce poured on them than we would have for concluding that a man tastes with his nostrils simply because he would object to having them filled with the same fluid. But on the other hand, this *apparent* sense of taste is, in many instances, nothing more than the insect's desire to clean off whatever may be put on its antennæ. Every one knows that they are mostly kept very clean by the insect at all times, and are, as a rule, of all parts of the body most free from extraneous matter. They seldom notice anything put to them unless it be of a nature to adhere to them. But as soon as anything, even pure water, sticks to them, they immediately draw them through the mouth-parts, and if it be anything palatable, as sugar, for instance, they begin to suck at it. But the very fact that often when they get anything distasteful they begin to spit and clean the mouth, is enough to show that they did not get a taste of it before they put it in the mouth. And aside from all this, who ever saw an insect use its antennæ to taste with? Butterflies and similar insects, when probing the deepest flowers, hold them nearly erect. Of many others, such as the bee, wasp, &c., they scarcely reach to the lower part of the head, not to take into account the length of the extended tongue.

2d. I do not think the power of *direction* is in the antennæ. It is true some insects seem to have lost the power of directing their flight when the antennæ are cut off. But besides the fact that *many* others are not so affected, we know that many of those that are, soon recover and are able to move about as well as ever.

3d. Lastly, I am inclined to adopt the opinion of Mr. Trouvelot that the antennæ are the organ of some sense not possessed by us. But I can hardly say with him that this sense is (if I un-

derstand him rightly) supplementary to that of sight. True it seems in many cases as though insects deprived of their antennæ are somewhat blind; but in vastly more instances they do not seem so. Take, for example, almost any beetle one may pick up. Cut off the antennæ and let them run, and we cannot get them to act in any way not as before. Whatever it be it is in a very different manner connected with the life of different insects. In many instances the deprivation of them seems almost fatal; in others again it is scarcely noticed. Cut them off from a sleeping roach and it will barely awake. Take your scissors and snip them from the gray "stinck bug" as it walks over your window sill or on your door step, and it will stop short where it is and sit still for hours in one place. All experiments of this kind are easily performed, and I hope that many who have even a very few moments to spare, will pay some attention to this part of science, so late in being fully investigated. If so, one object, at least, of this paper will be accomplished.

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ON THE POSITION OF THE COMPOSITÆ AND ORCHIDEÆ IN THE NATURAL SYSTEM.

BY JOSEPH F. JAMES.

THE various authors who have, at different times, written on systematic botany, have had different schemes for a natural arrangement of the orders of plants. Some have placed one order at the head of the system, some another. Hardly two seem to agree as to the ones which should follow in a natural sequence. The large majority of writers, if indeed not all, have considered the Polypetalous division of the Dicotyledons the most highly developed, and have placed the Gamopetalæ in the second, and the Apetalæ in the third class. Ever since the time of DeCandolle, in 1813, down to Bentham and Hooker, our latest authorities, the Ranunculaceæ have generally been placed at the head of the flowering plants. It is the intention, in the present paper, to show reasons why this should not be so, and to suggest another and very different arrangement of the orders.

It would be well at the outset to remark that no system of botany is to be regarded as unmodifiable. All opinions, all ideas, are liable to change, and the fact cannot be better stated than was expressed by Lindley, in 1845, in the preface to his Vegetable

Kingdom (p. XI). He says: "Consistency is but another word for obstinacy. All things are undergoing incessant change. Every science is in a state of progression, and of all others the science of observation most so. Since 1836 the views of the author have, of course, been altered in some respects, although they have experienced but little modification in others. This is inevitable in such a science as that of systematic botany, where the discovery of a few new facts or half a dozen fresh genera may instantly change the point of view from which a given object is observed. The author cannot regard perseverance in error commendable for the sake of what is idly called consistency; he would rather see false views corrected as the belief of their error arises. * * * All that we can do is to throw our pebbles upon the heap which shall hereafter, when they shall have sufficiently accumulated, become the landmark of systematic botany."

With our modern ideas and knowledge of botany, we have pretty nearly all come to the conclusion that any strictly lineal arrangement of plants is out of the question. Nor is the idea altogether a modern one, for we find many old writers expressing the same opinion. Says Lindley, in 1845: "It is impossible, from the nature of things, that any arrangement should exist which shall represent the natural relations of plants in a consecutive series. It is generally admitted by those who have turned their attention to a consideration of the manner in which organized beings are related to each other, that each species is allied to others in different degrees, and that such relationship is best expressed by rays (called affinities) proceeding from a given center (the species)." And Brongniart, in 1843, had also insisted on the impracticability of a lineal arrangement of plants.

Although it is universally admitted, however, that the Monocotyledons are of a lower type than the Dicotyledons, yet he would be rash, indeed, who would say that the highest of the former division should stand lower than the lowest of the latter. That, for instance, the Orchideæ should be below the Chenopodiaceæ or the Euphorbiaceæ. So that the only way in which we can with justice and method arrange plants, is on several parallel lines.

As evolutionists, botanists must acknowledge that all plants, Monocotyledons or Dicotyledons, have sprung from one source, but they must have diverged at a very early period, and now rep-

resent two of the largest branches of the great botanical tree. So that if we would find the plants of the two classes which are most closely allied, it must be with the lowest forms of each, rather than with the lowest forms of the one and the highest forms of the other. Leaving now for the present the consideration of the Monocotyledons as lower in organization and structure, let us turn to the Dicotyledons and see what disposition can be made of the various orders, and which ones deserve to take the highest rank in the scale.

The Polypetalæ, Gamopetalæ and Apetalæ are the three classes into which the Dicotyledons have been generally divided, a division which, though in many ways artificial, is yet natural enough to serve our present purpose. Now there are several things which must be taken into consideration as establishing a high rank in the vegetable kingdom. Every one knows that the office for which every plant exists in nature, its chief function, is the production of seed, and the manner in which this is performed may be regarded as indicating, to a great degree, the relative rank of a plant in the scheme. This being granted, it can hardly be denied that those plants which produce the most seed with the least expenditure of material, and have at the same time the most perfect provisions for cross-fertilization, and are also among the most dominant families, should take a very high, if not the highest rank in the system.

Now of all plants in the world, the Compositæ take the lead in point of numbers and importance. Roughly estimated they number from ten to twelve thousand, and thus form about one-tenth of the whole number of flowering plants known. In some countries they constitute one-sixth of the whole flora, so that if a dominant type or family is a mark of high rank, where else than at the head should we place the Compositæ? That it should stand high would be immediately inferred from its very dominance. For if not of a highly specialized type it would never have been able to hold its own and increase to such an enormous extent, and occupy so large a space in the flora of the world. We recognize man as the highest type of mammal, and he too is the most dominant and the most widespread. Another argument for the high rank of the Compositæ, is the fact that they have been developed from the first most profusely in the tropics. There where the climate has been the most equable, most con-

stantly the same, we find the metropolis of the order. There they are the most abundant. So, too, was man first developed in the tropics, or at least in countries with a tropical or semi-tropical climate.

But what argument, it might be asked, can be adduced to justify the statement that the Compositæ were first developed in the tropical regions? Principally because the season of flowering of nearly the whole family is, in the temperate regions, in summer or in fall. The further north the place of origin of a plant is, the earlier will it bloom in countries situated towards the equator. Nearly all the members, for instance, of the Ranunculaceæ which have a northern distribution, bloom very early in the spring. So those species of Compositæ with a northern extension bloom first, and only those, while the more southern forms come later into bloom in their northern habitats. So that we would seem justified in concluding that as so many of our Compositæ do not bloom with us in the temperate regions until late in summer or in autumn, that they have originated in the countries close to or on the equator.

Let us now look at the flowers. We find that what looks to a superficial observer like a single flower, and is the compound flower of the old botanists, is really a cluster, a head of perfect flowers set on a common receptacle. The central florets in the majority of the genera are all perfect and produce seed. In the Tubulifloræ, comprising the larger part of the family, we find many genera with the outer flowers modified for a special purpose. While the disk florets are tubular, with five lobes to the corolla, the outer ones often become ligulate; the lower part only remaining as a tube, and the upper portion spread out into a broad ray with from two to five teeth, representing the original lobes of the corolla. The ray flowers sometimes produce seed; oftener they are sterile, and their only purpose is to render the flower more conspicuous to insect visitors. Thus we find here a company of flowers sacrificing some of their number to benefit the rest. Further, again, we find the corollas destitute of calyxes, these being reduced to scales, pappus or bristles. Also we find a definite number of stamens, five, all perfect, all enclosed in the corolla tube and fastened into a ring, and shedding their pollen into the tube. Again, that the flowers are all proterandrous, and though the anthers and pistil are both present in each flower,

the arrangement is such as to prevent self-fertilization, unless very rarely. For as the pistil grows, it pushes the pollen out of the tube, and on reaching the outside, expands its lobes ready for fertilization, but not until then; and when, too, it is most likely to receive pollen from a neighboring plant or flower-head.

Surely then we have here, in the Compositæ, a very high type of flower. In the first place a very great saving of material is effected by the union of the separate petals, such as we find in the Polypetalæ, into one piece. Secondly, in the reduction of the calyx of the ordinary flower to pappus, bristles or scales, which often also answer as means of dissemination, we have another decided saving of material. Thirdly, the stamens being reduced to a small number, and being so arranged as to shed their pollen where it will not be lost, and is yet ready for use. Fourthly, the pistil being mature only after the pollen falls, is thus assured of a cross in fertilization, to the manifest benefit of the seed; and fifthly, the flowers being set upon a common receptacle, are more noticeable to insects, are more compact, more easily visited, and are more likely to produce a larger number of seed. Each one of these seeds, too, is separate, and that may be regarded as another mark of a high rank. So that taking all things together, I would place the large family Compositæ at the head of the Gamopetalæ, and as the head of that class, at the head of the whole vegetable kingdom.

It will be seen now that I regard the Gamopetalæ as of a more highly organized and specialized type than the Polypetalæ. For it seems to me that by the union of the separate parts of the corolla, and of the calyx into one piece, so much material has been saved to the plant, so many idle expenditures have been cut off, and the work is performed by fewer members and in a more perfect manner.

It is a difficult matter to say what order shall be regarded as standing next to the Compositæ in rank. The family has few near relatives, and is isolated in many respects from nearly all the other orders. But considering the Compositæ as the head of one line of development, it would seem that in the Labiatæ we have another order which is also, in many respects, highly specialized, and ought to be regarded as at the head of the next highest line in the Gamopetalæ. The family is as remarkable as the Compositæ in one way, as it stands nearly alone in its peculiarities,

and the genera are so much alike in general characteristics that LaMaout and Decaisne have termed it a "monotypic family." For to know one Labiate is to know all of them. The genera are separated on small characters, obscure and difficult to observe. But the high rank of the family is indicated in the peculiarly modified corolla, bi-labiate, with elaborate arrangements in many genera for cross-fertilization, and in the ovary. This last is so distinct from all other families, with a solitary exception, that it might be used as characterizing this family exclusively. The only other order, Boragineæ, which has the same sort of a deeply four-parted ovary, differs markedly in having regular flowers.

In placing Labiatæ next to Compositæ in rank, it should not be understood that it is done with the idea that one is descended from, or is a modified descendant of the other, but simply that in the Labiatæ we find, next to the Compositæ, the most highly organized family of plants. Their predominance in Southern Europe, where they have been subjected for so many centuries to such a fierce struggle for existence, may account in a measure for their peculiar development, and their ability to hold their own in the world. Their aggressive nature, too, is well shown in the fact, that out of fifty genera known to North America, nineteen of them, or more than one-third, have introduced species.

Closely allied to the Labiatæ, on the one hand, is the Verbenaceæ, and on the other the Boragineæ. It is, of course, impossible in this paper to indicate the position of all or even very many of the natural orders. Scrophularineæ should, however, stand somewhere near Boragineæ.

Leaving now the Gamopetalæ, let us turn to the Polypetalæ and examine some of the orders. Here again I would change many things, and first of all dethrone Ranunculaceæ. They are by no means entitled to the first place in any system. But it seems to me that here the Leguminosæ, as most specialized and organized in many respects, should take the first rank. The flowers of many of the Ranunculaceæ are of the simplest type, with five petals, indefinite stamens and many pistils; while in the Leguminosæ we find many very profoundly modified flowers, with ten stamens and the peculiar fruit known as a legume. The modifications in the corolla have, of course, reference to cross-fertilization. Many of the species cannot produce any seed with-

out the aid of insects, and the contrivances serving the same end are many and various. Those with Papilionaceous flowers we may consider as specially modified, and these include nearly three-fourths of the genera and a still larger proportion of the species. Laying special stress upon the seeds and means for cross-fertilization here, as we have before, we see good reason for calling the Leguminosæ highly organized plants. The leguminous fruit and the papilionaceous flowers, are two things found in no other family, and these two, or either one, will tell a legume as easily as the compact head of flowers will point out one of the Compositæ.

While the Leguminosæ are entitled to the highest rank in the Polypetalæ, the Compositæ hold the highest place of all, for the former fall below the latter because of the separation of the petals, the almost universal prevalence of a calyx, so profoundly modified in the Compositæ, the increased number of stamens, the smaller number of seeds produced, and their production in a pod instead of separately.

Closely allied to the Leguminosæ stand the Rosaceæ, but not so highly specialized, having simpler flowers, more numerous stamens and other characters. Allied to both of these is the order Saxifrageæ, and to it the Ranunculaceæ, and to the latter the Umbelliferæ. In numerical strength and in distribution too, do we find these several families arranged in much the same order. Leguminosæ with 6500 species, Rosaceæ with 1000, Umbellifera with 1300, and Ranunculaceæ with 540. In distribution the Leguminosæ have the widest range and are especially abundant in the tropics, the Rosaceæ come next, the Umbelliferæ third, being rare in the lowlands of the tropics, and the Ranunculaceæ are last, largely confined to temperate and arctic regions.

Referring now to the Monocotyledons, we find that of all the orders the Orchideæ is the largest, there being known at present between 4500 and 5000 species. The order thus stands third from Compositæ. We find the species of orchids to have a very local distribution, but the family itself is very widely scattered. Their metropolis, as with the Compositæ, is in the tropics, especially in America, and we find a large proportion of them to be epiphytes. From the fact of the species having such a local distribution, it will probably be found that when the tropics have been thoroughly explored, that the number of species will be ma-

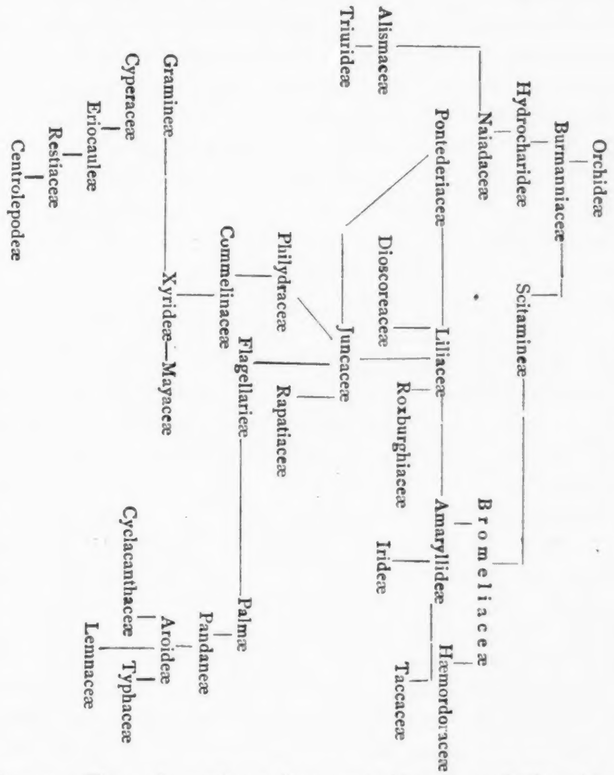
terially increased. Wallace (Tropical Nature, p. 50) says: " More than thirty years ago the number of known orchids was estimated by Dr. Lindley at 3000 species, and it is not improbable that they may be now nearly doubled. [We have seen this to be the case.] But whatever may be the numbers of the collected or described orchids, those that still remain to be discovered must be enormous. Unlike ferns the species have a very limited range, and it would require the systematic work of a good botanical collector during several years, to exhaust any productive district—say such an island as Java—of its orchids. It is not, therefore, at all improbable that this remarkable group may ultimately prove to be the most numerous of all the families of flowering plants."

The Orchideæ differ in a marked manner from all other plants, standing almost isolated. In no other order do we find such marvelous contrivances to bring about cross-fertilization. In many and in fact most instances the visits of insects are absolutely necessary in order to enable the plants to produce any seeds, and we could not find such a state of affairs unless the order was a highly developed one. Many of the species have been so profoundly modified, that only one kind of insect can be of use. Some of the gigantic orchids of Madagascar are absolutely dependent upon large moths which are found in the same island. In other species the sexes are separated, or there are two or three different kinds of flowers of the same species. One bears the pollen, another the stigma, and a third is provided with both. The peculiar modification which the pollen has undergone, the grains tied together by elastic threads, and the pollinia enclosed in anther cells, is unknown to any other family except the Asclepiadeæ, a family in no way connected with the Orchideæ. In point of fact, everything about the whole order shows it to be nearly equal in rank, in point of structure, with the other heads pointed out, viz., Compositæ and Leguminosæ. It would be folly to arrange any lineal scheme with Compositæ first, Leguminosæ second, and Orchideæ third. No one would dream of such a thing; but it is only just to say that each of these orders holds the highest place in each class it occupies.

In the scheme here given (see chart) I have arranged the orders of the Monocotyledons given by Bentham and Hooker. Placing Orchideæ at the head, we have affinities with Liliaceæ through Burmanniaceæ, Hydrocharideæ, Naiadaceæ and Pontederiaceæ;

and the Liliaceæ occupy the head of an alliance of which Juncaceæ may be considered the center. This alliance will include Amaryllideæ and Irideæ, and connect through Flagellarieæ with the Palmæ, which itself stands at the head of the Aroidal alliance, with Lemnaceæ in the lowest rank. On the other hand, Gramineæ and the other glumaceous plants are indirectly connected with Juncaceæ, and are at the head of the glumaceous

CHART OF THE MONOCOTYLEDONS.



alliance. Though perhaps incorrect in some of the details, I think that in placing Orchideæ, Liliaceæ, Palmæ and Gramineæ at the head of the four lines upon which the Monocotyledons have developed, that I am not very far from a natural scheme.

It will very readily be seen, now, how utterly impracticable it is to arrange plants lineally. How could it possibly be done? How could we, by taking the orders in the order of their highest

development, Orchideæ, Liliaceæ, Palmæ and Gramineæ, say that one was descended from or even directly connected with the others? It would be a violation of all principles of classification, and a libel on common sense. But when we take each order and show how, through this genus or that one, it is directly or remotely connected with some other one, then we feel a little confidence in saying we are approaching a natural classification. None of our systems can be entirely natural at present. We do not know, as yet, the characters and affinities of all the plants in the world, and until we do know that we cannot hope for anything but an approximation towards the correct idea of a perfectly natural arrangement of plants.

[*Note.*—This article was first read at a meeting of the Cincinnati Society of Natural History, and the first portion of it, viz., that relating to the Compositæ, was afterwards read at the Minneapolis meeting of the Am. Assoc. for the Adv. of Science.]

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ON THE HABITS OF CERTAIN SUNFISH.

BY C. C. ABBOTT, M.D.

ALTHOUGH the two small centrarchoids, *Mesogonistius chætodon*, or banded sunfish, and *Enneacanthus simulans*, or spotted sunfish, have been long known to ichthyologists, almost nothing has been recorded of their habits.

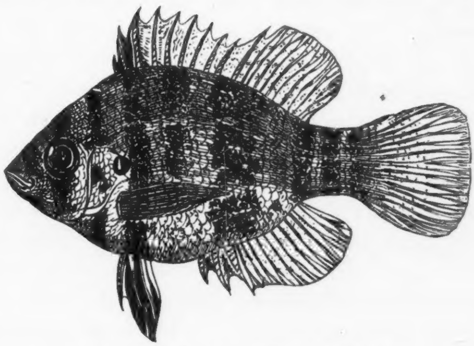
In those of our shallow, sluggish waters, which have an indefinitely deep, muddy bottom, and harbor a rank growth of aquatic vegetation, the handsome, silvery, black-banded sunfish is a common species. In such localities, where often the weeds grow so luxuriantly that a scoop-net cannot be drawn, I have found that hundreds of these fishes were passing what I think must be a most monotonous existence. In some places locomotion must be rather a scramble among the water weeds, than a comfortable swim. Still, these spots have their advantages, for among these plants are to be found myriads of insect larvæ and other small fry that constitute a never-failing supply of food.

As a fish for the aquarium the banded sunfishes are deservedly popular, and indeed, they are better known as dwellers in such narrow quarters than as a prominent species in the fauna of the Lower Delaware valley. I believe they are not found above tide water at all. I have frequently shown these fish to old fishermen

who rarely acknowledge that they have ever before seen them; and this fact is corroborative of what I had long supposed, that they are only to be found in out-of-the-way nooks and corners where game fish seldom if ever come, and that hence their haunts are not often invaded. In fact, one would scarcely expect to find any fish in some of the weed-grown holes in the meadows, where in truth scores of banded sunfish are quietly taking their ease.

Occasionally, however, I have seen this fish wander into quite open waters, and here it is that it shows to such advantage when, with its brilliant black dorsal and ventral fins spread, it moves majestically along.

Although so small, it is a plucky fish, and promptly resents any interference. Being a feeble swimmer, it depends, for defense, upon the sharp spines of its dorsal fin, and it seems to know that



Banded Sunfish (*Mesogonistius chætodon*).

when these are erected it is quite free from molestation. Especially angry does it become when a great lubberly catfish chances to wander near by and pokes his slimy nose into its haunts. At once the "bandy" is up in arms, and darts at the intruder with great violence. It is a veritable case of the king-bird and the crow over again, only beneath the water instead of in the air.

I am still in the dark about the breeding habits of this fish. At times I have thought that it scooped out a nest in the sand, as the common sunfish (*Lepomis gibbosus*) does, but I am not so sure about it. During the spring of 1881 I found females of this species heavy with immature ova, and I am now of the opinion that if any nest is made it is in comparatively deep water, among the lily stems, or at the base of some projecting root. Certainly if

anywhere in open water I should have found them before this. A puzzling fact that haunted me whenever I went fishing, until very recently (September, 1883), was, that I never found any very young "bandies," as I usually call them. I had often scooped up scores of the mud-loving Enneacanthi, found in the same quarters, but with never a "bandy" among them. Hoping ever for better things, I continued to search for them, and at last success crowned my efforts. Early in September last I found scores of little ones, some not more than half an inch in length. It is safe to say, therefore, that the ova are deposited in May or June. Just where, remains to be determined.

A very constant companion of the preceding, to which I have briefly referred as the spotted sunfish (*Enneacanthus simulans*) has, one would think, essentially the same habits as the banded fish. I have seldom, if ever, found them dissociated. They are even more numerous. The relative abundance of the two is about as two to five, the larger number referring to the Enneacanthus. Like all centrarchoids they are carnivorous, and feed upon living prey. During a recent ramble along Watson's creek, I saw quite a commotion in the shallow water near shore, and on approaching the spot I discovered that three of these spotted sunfish had attacked a crayfish which had just cast its shell. The battle lasted but for a moment after I became a spectator. One by one the limbs of the crustacean were torn off, and portions of them devoured by the fish in full view of their tortured victim. When I see such sights as these, I cannot but think that there is a screw loose in nature—that nothing is perfect, and animal life is only reaching out towards perfection.

I have said that these two sunfish have apparently the same habits, but it is a case wherein appearances are misleading. Considering that they are so very dissimilar in color, and generically distinct, it recently occurred to me to determine, if possible, if there were not points of difference which I had overlooked. Gathering a large number of specimens from the same locality, I noticed that with a seine drawn over a considerable space, many of the two fishes were taken; but, when a scoop-net was used, if a cluster of spatter docks (*Nuphar luteum*, var. *pumilum*) was covered, I ordinarily captured specimens of the banded sunfish, and the spotted sunfish were taken from masses of Myriophyllum of different species. This was not invariably the case,

but so generally that I concluded that the growths of *Nuphar luteum* and similar plants were the favorite haunts of the banded sunfish, and the muddy masses of Myriophyllum harbored the spotted species.

On submitting the specimens to Dr. A. C. Stokes, of Trenton, N. J., he kindly examined the contents of the stomachs of these species by the aid of the microscope, with the following results:

In the stomachs of a dozen or more adult banded sunfish he found Chironomus larvæ very numerous; *Cyclops quadricornis* numerous; Daphnia sp. numerous; chitinous parts of small insects present but not abundant; diatoms, desmids and fragments of algæ, probably accidental; and a single rhizopod (*Centropyxis aculeata*). In very young fish he found Chironomus larvæ few, and *Cyclops quadricornis* and Daphnia sp. numerous.

He adds, "In the stomach of a full-grown fish there was from seventy-five to one hundred Chironomus larvæ, which seem to be the favorite food." This shows at a glance that the banded sunfish is essentially a surface feeder, and as we seldom see them moving about in the open water or near the surface, they are probably nocturnal in their habits. In an aquarium, however, they seem to be as active during the day, as at night, although averse to exposure to direct sunlight.

The examination of twelve adult specimens of spotted sunfish, resulted as follows:

In every case the stomach was empty, but the intestine contained tracheæ, eyes, elytra, heads and chitinous parts of small aquatic beetles. These were very numerous; also Pisidium sp. occasional; several small univalve mollusks; a few Chironomus larvæ; occasionally a Daphnia and Cyclops; and Gammarus sp. numerous. In the very young spotted sunfish examined, there were found Pisidium sp. occasionally; many Daphnia and Chironomus larvæ; a few fragments of insects; many Cyclops; a few very small univalve mollusks, and a single water mite.

Here we have evidence that this species of sunfish is a bottom feeder, and resorts to the mud rather than elsewhere for its main food supply.

I have already mentioned the great difference in the coloration of these two sunfish, which are, as we have seen, quite intimately associated. Whether this difference has any direct relation to their widely different feeding habits, I will not now essay to determine.

EDITORS' TABLE.

EDITORS: A. S. PACKARD, JR., AND E. D. COPE.

—— We are just at present having, on both sides of the water, a series of jeremiads preached by the high priests or prophets of science. It is perhaps well, at times, to go out into the streets, to sit down in sackcloth and ashes, to bewail our situation, and to improve the opportunity by asking alms of the passers-by. Professor Lankester appears before the British Association, tells the British public some plain if bitter truths concerning the endowment of scientific research, and then coolly asks alms of the British government for England alone (Scotland and Ireland left out) to the amount of the annual interest on two million pounds.

We wish the English government could be brought for a period of one generation to make annual grants to that amount. It would literally be a costly experiment, but that enormously rich government has made, and is making in other directions, vastly costlier ones.

It is the fashion to depreciate the state of science in France, but that republic votes annually large sums of money for public education, higher as well as lower, which might well put to the blush Great Britain and the United States. Meanwhile laboratories for scientific research have been built at Roscoff, Concarneau, Villefranche, Banyuls and elsewhere, founded by private means, where England has at present nothing to compare with those institutions. Who in England is doing such work in fine anatomy and histology as Lacaze-Duthiers, Balbiani, Kunckel-d'Herculais and Viallanes? What publications are there in England to offset the *Annales des Sciences Naturelles* and Lacaze-Duthiers' magnificent journal? The only English journal of the sort is the excellent *Quarterly Journal of Microscopical Science*, which, however, is partly filled with the work of German-bred and American students. We do not wish to be thought to detract from English science, for in biology she can point to rare men like Darwin and Balfour, Bentham and Hooker, Owen and Huxley.

The German government is at present engaged in the manufacture of soldiers and scientists; her men of family rank and inherited genius are largely to be found among the latter; but politically the German people are in leading strings, and the

strings have been tightened within two or three years. Let imperialism feed its soldiers and scientists, banish too inquisitive and turbulent savants, like Vogt and Fritz Müller, socially snub its professors, and meanwhile build its splendid laboratories and museums. It is perhaps laying the foundations for the future political and social advancement of the masses.

In this country the people may never, to any great extent, sanction special educational grants beyond what the Government is now doing for its scientific commissions. We must look to private generosity. Our people are developing national character; every man, scientist or factory-hand, is, besides attending to his specialty, doing his part in "running" the Government. We cannot afford to develop and train a privileged class of soldiers and scientists; strong in their specialty, weak in morals and statesmanship and all that make masterful minds. Still, jeremiads as applied to the United States are only too true. There is little danger that science in this country will be too much pampered. As has been insisted in this journal, and as Professor Rowland, in his many respects admirable address, emphasized, we tend towards mediocrity. That is one great danger of democracies.

And after all, as much as money is needed to aid in scientific research, there is a greater demand for men and brains. There are now living in this country numbers of young men of leisure and means who might devote themselves to science, or at least aid those who are working for science, by assisting in organizing and managing, as well as raising funds for the numerous scientific organizations now arising in our cities. College corporations should elect into their bodies more young men who sympathize in the higher education, which, it may be said, is not all confined to so-called colleges; post-graduate courses, scholarships and fellowships might be attached to the smaller colleges through the liberality of liberal-minded men of wealth; there are always to be found one or two graduates in any college who could be trained in original research; our laboratories and museums might be more effectually manned if our leading citizens were more fully aware of their necessities. Science is becoming widely popularized in the present generation, and the fruits will be seen in the next. But in a country like ours, the government alone need not undertake the task of creating a body of scientists; that work should be done by the people and for the people. The time is coming when our people will be less materialistic, and when those who are well-off already will cease trying to accumulate more wealth, but turn their attention to "rolling up" the intellectual and scientific capital of our domain.

RECENT LITERATURE.

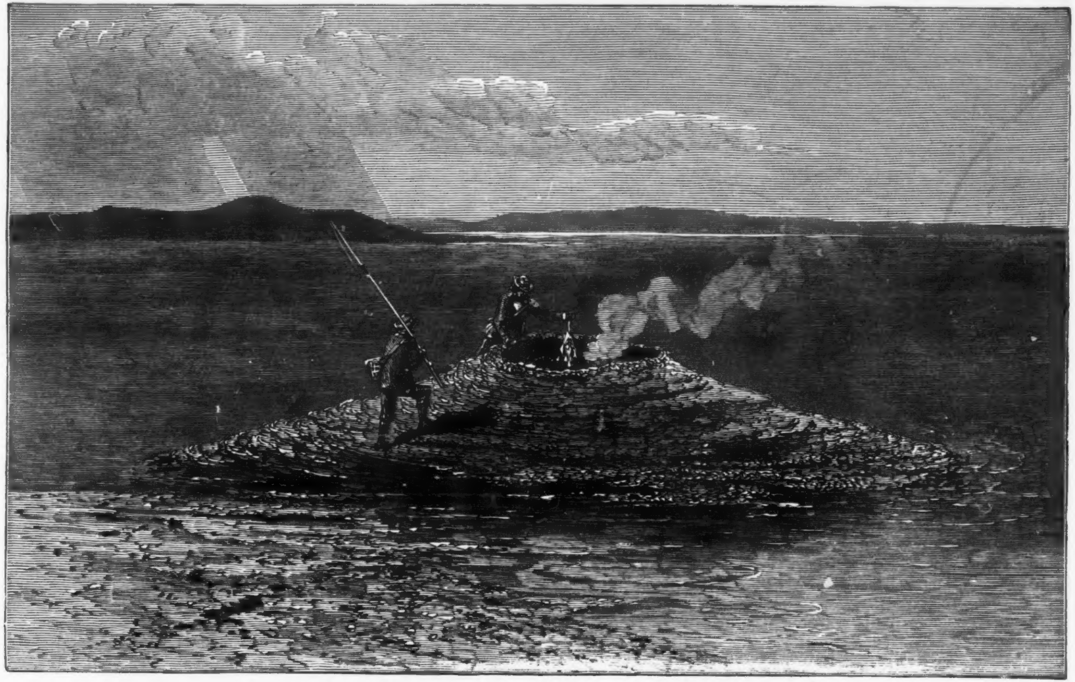
HAYDEN'S TWELFTH ANNUAL REPORT OF THE U. S. GEOGRAPHICAL AND GEOLOGICAL SURVEY OF THE TERRITORIES OF WYOMING AND IDAHO.—These bulky and very richly illustrated volumes form the last of a series of twelve annual reports covering as many years, from 1867 to 1879, and which is notable for containing a vast amount of valuable information concerning the geology and natural resources of an immense area lying west of the Mississippi valley and east of the Sierra Nevada range. It will be remembered that June 30, 1879, Congress passed a law discontinuing this and the two other surveys then in existence, and establishing what is now known as the United States Geological Survey.

Part I contains under the head of geology, seven illustrated articles by Dr. C. A. White, entitled Contributions to Invertebrate Palæontology, 2–7, the first having appeared in the report of the survey for 1877; with the report of Mr. O. St. John on the geology of the Wind River district, and of Mr. Scudder on the Tertiary lake basin at Florissant, Col., the latter being a reprint from the last volume of the Bulletin of the Survey. To return to Dr. White's articles, which are illustrated by thirty-one excellent plates, among the large number of new forms described the most remarkable are two coral-like Cretaceous forms with a Palæozoic aspect, one referred with a good deal of doubt to Chætetes, though the tabulæ are apparently absent, and it may be a Polyzoön; the other coral is referred with doubt to Beaumontia. Another palæontological fact of interest is the discovery in the Cretaceous rocks near San Antonio, Texas, of a very large crab's claw, described by Mr. Whitfield under the name of *Paramithrax walkeri.*

Mr. St. John's account of the geology of the Wind River district occupies eighty pages of the volume, and is richly illustrated with panoramic views and chromo-lithographic plates by Mr. W. H. Holmes, whose sketches are unique for their wonderful presentation of geological and typographical facts combined. The frontispiece, giving a view of Pike's Peak and the Garden of the Gods, is an excellent piěce of chromolithography; as good and faithful as we remember to have seen.

As Dr. Hayden remarks in the preface, the Wind River range proved one of remarkable interest. "It has a trend about north-west and south-east, with a length of about a hundred miles. On the west side all the sedimentary belts have been swept away, down to the Archæan, older than the Wasatch, and the latter formation rests on the Archæan rocks all along the base of the range, seldom inclining more than 5° to 10°. On the east side of the range the series of sedimentary formations usually known to occur in the north-west are exposed from the Potsdam sand-

PLATE XX.

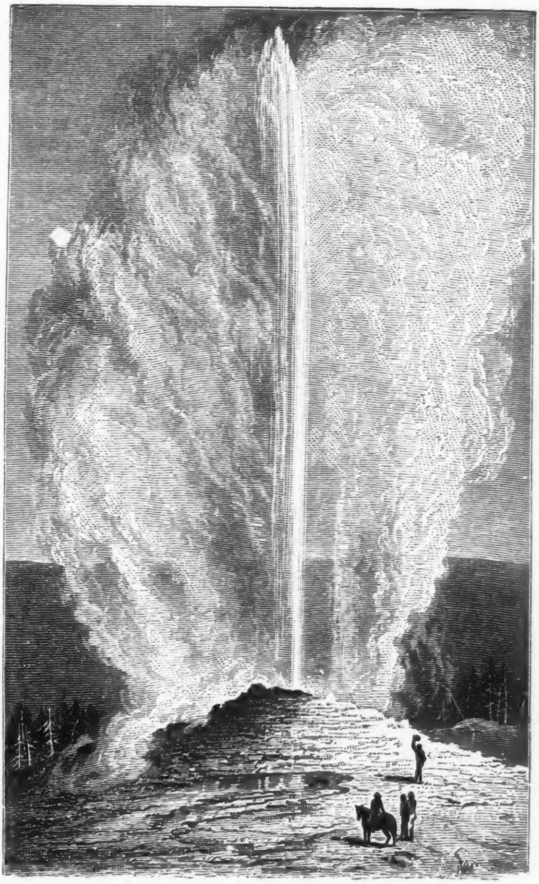


Hot Spring Cone on west arm of Yellowstone lake.

PLATE XXI.

Giant Geyser in action.

PLATE XXII.



Old Faithful Geyser in action, 1871.

stone, which rests upon the Archæan rocks, to the Cretaceous, inclusive." The range is regarded as a vast anticlinal of which one side has been entirely denuded of the sedimentary rocks, except the Middle Tertiary. On the same side of the range the morainal deposits and glaciated rocks are shown on a scale not met with by Hayden in other parts of the West. The most interesting discovery made by the survey in this district was that of three genuine glaciers on the east base of Wind River and Fremont peaks, the first known to exist east of the Pacific coast. The panoramic view on a large scale, by Mr. Holmes, of these glaciers, conveys an excellent idea of their appearance. That they were formerly much larger is shown by the moraines which were found on a grand scale in the Snake River valley, on the east side of the Téton range. The numerous lakes have been the beds of glaciers, and the shores of the lakes are walled with morainal ridges.

The second section of the volume is devoted to zoölogy, comprising a monograph by Professor A. S. Packard, Jr., of the Phyllopod Crustacea, one family of which is confined, south of the Arctic regions, to the United States west of the Mississippi river. It contains a chapter on the reproductive habits of the Phyllopods, comprising the life-history of *Apus lucasanus*, etc., by Dr. C. F. Gissler, and an appendix containing translations of the papers of Siebold and of Schmankewitsch on the transformations of Artemia and its relations to its environment. The essay comprises also a general account of the Phyllocarida, a new order of Crustacea of which Nebalia is the modern type, with a number of fossil forms usually referred to the Phyllopoda. The essay comprises 210 pages, and is illustrated by wood-cuts, and thirty-nine plates, with a colored zoögeographical map. This is followed by a series of five articles by Dr. R. W. Shufeldt, U.S.N., on the osteology of *Speotyto cunicularia*, *Eremophila alpestris*, of North American Tetraonidæ, of *Lanius ludovicianus excubitoides* and of the Cathartidæ. These are important contributions to a neglected subject, and are richly illustrated with numerous woodcuts and twenty-four lithographic plates.

The second part forms a bulky volume of 500 pages, and is entirely devoted to an account of the Yellowstone National Park, and its geysers. It is illustrated by several very effective chromolithographs, a number of excellent wood-cuts, several of which we are kindly allowed to reproduce (Plates XX–XXIII), a large number of Mr. Holmes' characteristic panoramic views, and numerous maps by Mr. Gannett, while in the atlas of maps is a large geological map of the park. The whole is a most thorough and timely monographic account of the park. It will be remembered that the idea of setting apart this large tract as a national park originated with Dr. Hayden.

The geology of the Yellowstone Park is by Mr. W. H. Holmes, who describes the structure of the Yellowstone valley and its tributaries as well as the mountain ranges; of these the two most important, the Yellowstone and Washburn ranges, are composed of volcanic conglomerates, the larger part of the park being underlaid by rhyolite. The greater part of the volume, which relates to thermal springs and geysers, is treated in a broad and comprehensive way by Dr. C. A. Peale, and is an important contribution to this attractive subject. After describing the springs and geysers of the park, he discusses thermal springs and geysers in general, including those of Iceland, New Zealand, those of other parts of the United States, those of Mexico, Central America, the West Indies and South America, as well as those of Europe, the Azores, Africa, Indian ocean, Asia Minor and Asia, with those of Japan, Formosa, Malaysia, Australasia and Polynesia. Thermohydrology is then discussed under the heads of thermal springs, the chemistry of thermal waters (by C. A. Peale and Henry Leffmann), their formations and deposits, and the chemistry of deposits (also by Peale and Leffmann); this part closing with an account of geysers and theories of geysers, followed by a full bibliography of the subject. Dr. Peale describes and tabulates over two thousand springs and seventy-one geysers. The preliminary work on the geysers and geology of this world-renowned park has now been accomplished, but years of careful scientific work will be required to fill out the details. The report closes with a geographical account of the park, richly illustrated with maps by Mr. Henry Gannett, and the report of this distinguished geographer is a model of conciseness and critical accuracy. The entire report does great credit to the conduct of this famous survey and to the energy and foresightedness of the distinguished director.

Brooks' Law of Heredity.[1]—This work is an elaborate attempt at a solution of the difficult problem of heredity, the author's theory being in a degree based upon Darwin's hypothesis of pangenesis.

The plan of the book is as follows: After giving first an outline of the chief hypotheses which have been published in explanation of heredity, with reasons for rejecting them, the author presents briefly, in outline, a statement of his own theory. He then attempts to show that this theory furnishes a basis for the theory of natural selection, that there is no *a priori* reason for rejecting this theory of heredity, and that it furnishes an explanation of many well-known facts which the author claims cannot without it be seen in their true relations. Finally the author at-

[1] *The Law of Heredity.* A study of the cause of Variation and the Origin of Living Organisms. By W. K. Brooks, associate in Biology, Johns Hopkins University. Baltimore, John Murphy & Co. 1883. 12mo, pp. 336. With illustrations.

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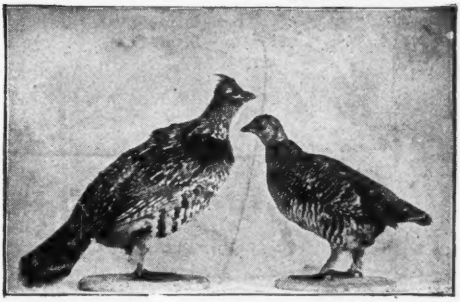
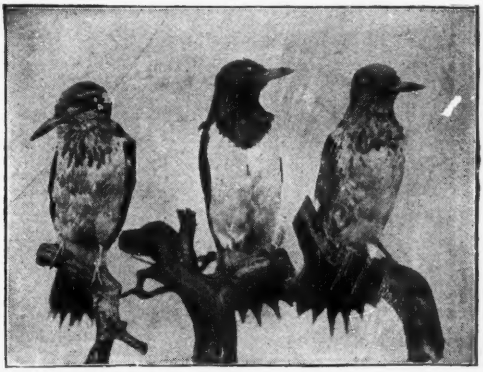
PLATE XXIV.



MALE. FEMALE.

MALE AND FEMALE RUFFED GROUSE.

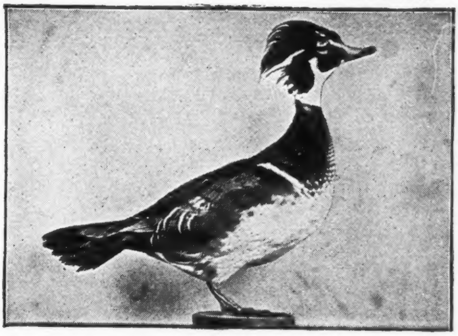


YOUNG MALE. ADULT MALE. ADULT FEMALE.

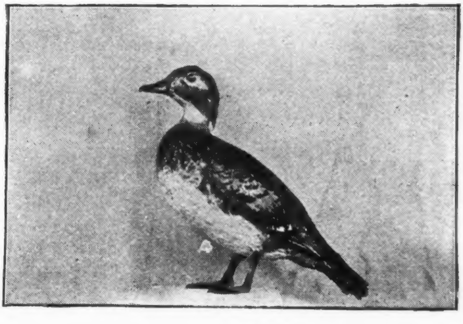
ADULT MALE, YOUNG MALE AND ADULT FEMALE OF THE RED HEADED WOODPECKER.

[From photographs of stuffed specimens in the collection at Druid Hill Park, Baltimore.]

PLATE XXV.



MALE.



FEMALE.

MALE AND FEMALE WOOD DUCK, TO SHOW SECONDARY SEXUAL CHARACTERS.

[From photographs of stuffed specimens in the Collection of the Maryland Academy of Sciences.]

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tempts to show that it is supported by direct proof, and the work closes with an extended statement of the theory.

Professor Brooks' theory we will state in his own words: "The union of two sexual elements gives variability. Conjugation is the primitive form of sexual reproduction. Here the functions of the two elements are alike, and the union of parts derived from the bodies of two parents simply insures variability in the offspring. In all multicellular organisms the ovum and the male cell have gradually become specialized in different directions.

"The ovum is a cell which has gradually acquired a complicated organization, and which contains material particles of some kind to correspond to each of the hereditary characteristics of the species. The ovum, like other cells, is able to reproduce its like, and it not only gives rise, during its development, to the divergent cells of the organism, but also to cells like itself. The ovarian ova of the offspring are these latter cells, or their direct unmodified descendants.

"Each cell of the body is, in a morphological sense, an independent individual. It has the power to grow, to give rise, by division, to similar cells, and to throw off minute germs. During the evolution of the species it has, by natural selection, acquired distinctive properties or functions, which are adapted to the conditions under which it is placed. So long as these conditions remain unchanged, it performs its proper functions as a part of the body; but when, through a change in its environment, its function is disturbed and its conditions of life become unfavorable, it throws off small particles which are the germs or 'gemmules' of this particular cell.

"These germs may be carried to all parts of the body. They may penetrate to an ovarian ovum or to a bud, but the male cell has gradually acquired, as its special and distinctive function, a peculiar power to gather and store up germs.

"When the ovum is fertilized each germ or 'gemmule' unites with, conjugates with or impregnates that particle of the ovum which is destined to give rise in the offspring to the cell which corresponds to the one which produced the germ or gemmule; or else it unites with a closely related particle, destined to give rise to a closely related cell.

"When this cell becomes developed in the body of the offspring it will be a hybrid, and it will therefore tend to vary.

"As the ovarian ova of the offspring share by direct inheritance all the properties of the fertilized ovum, the organisms to which they ultimately give rise will tend to vary in the same way.

"A cell which has thus varied will continue to throw off gemmules, and thus to transmit variability to the corresponding part in the bodies of successive generations of descendants until a favorable variation is seized upon by natural selection.

"As the ovum which produced the organism thus selected will

transmit the same variation to its ovarian ova by direct inheritance, the characteristic will be established as an hereditary race-characteristic, and will be perpetuated and transmitted, by the selected individuals and their descendants, without gemmules.

"According to this view, the origin of a new variation is neither purely fortuitous nor due to the direct and definite modifying influence of changed conditions. A change in the environment of a cell causes it to throw off gemmules, and thus to transmit to descendants a tendency to vary in the part which is affected by the change.

"The occurrence of a variation is due to the direct action of external conditions, but its precise character is not. My view of the cause of variation is thus seen to be midway between that accepted by Darwin and that advocated by Semper and other Lamarckians."

In a word then, Brooks' theory maintains that these gemmules only by chance pervade the whole body, but are, as a rule, confined to the male cell or spermatozoön, hence the male element is the originating and the female the perpetuating factor; the ovum is conservative; the male cell progressive. Heredity or adherence to type is brought about by the ovum; variation and adaptation through the male element, and the ovum is the essential, the male cell the secondary factor in heredity.

This theory is naturally open to the same general objection as that of pangenesis, which was, as Professor Brooks admits, effectually disproved by Galton's experiment, in which the transfusion of blood from certain varieties of rabbits into that of the silver-gray rabbit, produced no effect. These gemmules are metaphysical conceptions; they probably can never be detected. To test the theory properly we should think experiments might be made by inoculating with the supposed gemmules the testes of different mollusks or other low animals; but none have been reported by our author. As a speculation it is a very neat one, and the arguments and facts brought forward, most of them, however, from Darwin's works, will be read with interest. The theory is carefully thought out, well presented, and the work is a contribution of permanent value to a most difficult and elusive topic in philosophical biology.

We think still more might have been presented in the way of facts bearing upon the subject of the direct action of external conditions, and we think that this is of nearly equal importance, or rather affords the foundation for the action of heredity, as it is the source of most, if not all, variation, though we may be unable always to detect the operation of the law.

Speculation in good hands has always been a fruitful source of discovery, and the simple endeavor to discover the laws of heredity may at least lead to fresh fields of research.

After stating the theory, our author devotes a large part of the

volume to a detailed statement of the evidence from hybrids, from variation, from secondary sexual characters; and this chapter is illustrated with the excellent figures here reproduced (Plates XXIV, XXV), which will speak for themselves.

In the tenth chapter the author considers the evidence from the intellectual differences between men and women; in the next chapter the author's theory is considered as supplementary to the theory of natural selection, the last chapter being in the way of recapitulation and conclusion.

Now and then the author shows a tendency to take for granted matters still in dispute, as, for instance, the nature of the process of conjugation, which is, if we understand it, not proved to be of the nature of sexual reproduction, though it would seem to be such. There are a number of slight but unneccessary typographical errors, and a word or two, such as Branchipus, is misspelt.

TRANSACTIONS OF THE KANSAS ACADEMY OF SCIENCE FOR 1881–2.—The eighth volume of this enterprising academy contains, among others, the following papers: The coal fields of Cherokee county, by E. Haworth; a preliminary list of fossils found in Riley county, by S. C. Mason; the igneous rocks of Kansas, by R. Hay; are there igneous rocks in Cherokee county? by E. Haworth; fossil wood, by R. Hay; protozoan remains in Kansas chalk, by G. E. Patrick; lists of Lepidoptera and Coleoptera collected in New Mexico by the Kansas University scientific expeditions of 1881 and 1882, by F. H. Snow; on the moths collected by Professor Snow in New Mexico, by A. R. Grote; observations of the nesting habits of the guillemots at Bird Rock, by N. S. Goss; notes on *Meleagris ocellata*, by G. F. Gaumer; notes on the habits of certain *Momotidæ*, by G. F. Gaumer; a contribution to the history of the fresh-water Copepoda, by F. W. Cragin (with four plates).

GALTON'S HUMAN FACULTY AND ITS DEVELOPMENT.[1] — This somewhat disjointed series of essays, though none the less interesting on that account, is the result of the author's wanderings into the highways and especially the byways of human psychology. Its perusal leaves one very distinct impression on the mind: the fact that there are striking differences between the minds of even closely related persons. As a shepherd knows individually each member of a large flock, so the attentive student of minds and human organizations recognizes a greater amount of individuality in men than the common observer realizes. That no two persons are alike bodily and mentally is of course universally acknowledged, and is almost axiomatic, but Mr. Galton makes us realize this fact as never before.

The book is a collection of scattered essays, published in dif-

[1] *Inquiries into Human Faculty and its Development.* By FRANCIS GALTON F.R.S. New York, Macmillan & Co., 1883. 8vo, pp. 380, with illustrations.

ferent journals, which are brought together with some revision, condensation and rewriting. The author's object has been "to take note of the varied hereditary faculties of different men, and of the great differences in different families and races, to learn how far history may have shown the practicability of supplanting inefficient human stock by better strains, and to consider whether it might not be our duty to do so by such efforts as may be reasonable, thus exerting ourselves to further the ends of evolution more rapidly and with less distress than if events were left to their own course."

The variety of the subjects treated will be seen by the following contents: Variety of human nature, features, composite portraiture, bodily qualities, energy, sensitivity, sequence of test weights, whistles for audibility of shrill notes, anthropometric registers, unconsciousness of peculiarities, statistical methods, character, criminals and the insane, gregarious and slavish instincts, intellectual differences, mental imagery, number-forms, color associations, visionaries, nurture and nature, associations, psychometric experiments, antechamber of consciousness, early sentiments, history of twins, domestication of animals, possibilities of theocratic intervention, objective efficacy of prayer, enthusiasm, the observed order of events, selection and race, influence of man upon race, population, early and late marriages, marks for family merit, endowments, conclusion.

The relations of these subjects to morals and ethics, as treated by Mr. Galton, and also by other writers of what is sometimes called the positive school, from the inductive and evolutionary standpoint, shows what man may do for the improvement of his own race.

As the author says, we cannot but recognize the vast variety of natural faculty, useful and harmful, in members of the same race, and much more in the human family at large, all of which tend to be transmitted by inheritance. Neither can we fail to observe that the faculties of men generally are unequal to the requirements of a high and growing civilization. This Galton attributes to their uncivilized ancestry, and "the somewhat capricious distribution, in late times, of inherited wealth, which affords various degrees of immunity from the usual selective agencies." The fact that "the very foundation and outcome of the human mind is dependent on race, and that the qualities of race vary, and therefore that humanity, taken as a whole, is not fixed but variable," leads him to consider what may be the true place and function of man in the order of the world. We should, he thinks, look upon ourselves as members of "a vast system which, in one of its aspects, resembles a cosmic republic." Hence while "recognizing the awful mystery of conscious existence and the inscrutable background of evolution," he suggests that man ought to be less diffident than he is usually instructed to be, and "to

rise to the conception that he has a considerable function to perform in the order of events, and that his exertions are needed; that he should look upon himself more "as a freeman, with power of shaping the course of future humanity." The question, "How man can assist in the order of events," he answers, "by furthering the course of evolution." This means that man "may use his intelligence to discover and expedite the changes that are necessary to adapt circumstances to race and race to circumstances, and his kindly sympathy will urge him to effect them mercifully."

The book should be read by physicians, moralists, philanthropists, biologists and intelligent parents, as well as the civil service reformer, in fact by everyone interested in the advancement of mankind, whether they accept all the author's conclusions or not.

THE TORTUGAS AND FLORIDA REEFS.[1]—Professor Agassiz commences this memoir by the statement that Darwin's theory of reef formation will not apply to the peculiar conditions existing along the Straits of Florida. The southern extremity of Florida was shown by the elder Agassiz to be of comparatively recent growth, and the mode of growth of the present reef, keys and mud-flats to be identical in its nature with past action. The whole southern part of Florida is built of concentric barrier reefs, cemented into continuous land by the accumulation and consolidation of mud flats between them. The curve of the Florida reefs is due, in great part, to a counter current running westward along the reef. When storms occur, the fine silt of the bank is taken into the bay back of the keys and deposited there. The counter current then carries this to the westward, and thus material is added to the flats. No trace of Mississippi mud has ever been found in any of the soundings taken east of the Mississippi. The line of keys seems to be formed by the waste of the present reef, rather than by the remains of an older anterior reef. The Tortugas at the very extremity of the slope upon which the line of the Florida reefs has been built up, are the most recent of the reefs, and are as yet without the mud flat on their northern side. For the production of such a group it is evident that a knoll must first have been raised from the ocean bottom to a depth at which it is possible for corals to live. Such a knoll may well have been formed by the detritus driven to the westward by the prevailing easterly winds and the currents running westward. An incipient coral reef is already forming upon a patch to the westward of Tortugas. The backbone of Florida was first produced by a fold in the earth's crust, but in the northern portion of the Everglades commences the series of concentric reefs which have, little by little, built up Florida toward the south. The

[1] *The Tortugas and Florida Reefs.* By ALEXANDER AGASSIZ. From Memoirs of American Academy of Arts and Sciences, Vol. XI.

amount of animal life which can be sustained upon a small area, under suitable conditions, can only be understood by those who have dredged near the hundred fathom line on the west coast of the great Florida plateau. The dredge not unfrequently brings up large fragments of modern limestone, consisting of the dead carcasses of the species now living on the top.

The *Challenger* and *Tuscarora* soundings have shown the existence of submarine elevations of volcanic origin, forming extensive banks, serving as foundations for barrier reefs and atolls, and wherever such plateaux reach, on their windward side, a level at which corals prosper, there coral reefs spring up and flourish. At lower levels are plateaux where mollusks, corals, echinoderms, etc., find the materials necessary for their coverings. These great submarine beds of modern limestone lie in the very track of the ocean currents, and gain from them the carbonate of lime they require. Murray's experiments seem to prove that this amounts to sixteen tons for every square mile a hundred fathoms deep. The foundation for a coral reef is formed by the accumulation of limestone and other animal remains upon an early fold of the earth's crust, or upon a volcanic plateau, and corals do not encrust the surface until the bank has risen to their bathymetrical limit. Thus the deposition of animal débris comes in as a supplement to elevation and subsidence, which alone were taken note of by the theory of Darwin and Dana, and accounts for the raising of plateaux in regions where there has been little or no change of level from other causes, to a height favorable for the growth of reef-building corals.

GROFF'S MINERAL ANALYSIS.[1]—This is a series of one hundred octavo pages giving blanks for the student to fill out under the different physical characters and chemical reactions of minerals. They are conveniently arranged and accompanied by a syllabus of terms most commonly used in describing minerals. It will be found useful in laboratory work.

RECENT BOOKS AND PAMPHLETS.

Upham, Warren.—Lake Agassiz, a chapter in Glacial Geology. Ext. Bull. Minn. Acad. N. S., Vol. II. From the author.

Harger, Oscar.—Report on the Isopoda. Bull. Mus. Comp. Anat., Vol. XI, No. 4. Cambridge, 1883. From the author.

Dewey, F. P.—Porosity and specific gravity of Coke. Ext. Trans. Amer. Inst. Mining Eng., 1883.

Hunt, A. E.—Some notes and tests of an open-hearth steel charge made for boiler plate. Ext. idem.

Stone, G. C.—The determination of Manganese in Spinel. Ext. idem.

Brinton, D. G.—The Folk-lore of Yucatan. Ext. from the Folk-lore Journal, Vol. I, Pt. VIII, London, Eng., 1883. From the author.

Allen A.—The Journal of the Postal Microscopical Society, London, 1883. From the editor.

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[1] *Mineral Analysis.* Designed by Professor Geo. G. Groff, M.D. Second edition. Lewisburg, Pa., Science and Health Publishing Co., 1883. 8vo.

White, J. W.—First aid to the Injured. Abstract of lectures delivered to the police of Phila. From the author.

Boehm, G.—Literaturbericht für Zoologie in Bezeihung zur Anthropologie mit Einschluss der fossilen Landsaugethiere. Abd. Arch. für Anthropologie. Munchen, 1883. From the author.

Hoffmann, C. K.—Dr. H. G. Bronn's Klassen und Ordnungen des Thier-Reichs. V Band, II Abth. Arthropoda. VI Band, III Abth. Reptilien.

Leche, W.—Zur Anatomie der Becken region bei Insectivora, Stockholm, 1883. From the author.

Gregorio, M. A.—Intorne alla Publicazione di un gran Giornale Geologico Internazionale. From the author,

Agassiz, A.—Exploration of the surface fauna of the Gulf Stream. Vol. III, Part I. The Porpitidæ and Velellidæ. Cambridge, 1883. From the author.

Cragin, F. W.—A contribution to the history of the fresh-water Copepoda. Ext, Trans. Kansas Acad. Sci., 1883. From the author.

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GENERAL NOTES.

GEOGRAPHY AND TRAVELS.[1]

The Dutch Circumpolar Expedition.—On July 5, 1882, the Dutch expedition embarked on the Norwegian steamer *Varna*. Before the end of August the *Varna* was surrounded by ice at about 70° N. lat. and 63° E. long. On September 18th the Danish steamer *Dijmphna* perceived the ship and attempted to render aid, but was itself surrounded by ice, and soon both ships were frozen in at about seventy-five yards distance from each other. At the commencement of October enormous crevasses opened in the ice, heralded by loud noises of cracking and splitting, and the crew, who at the first warning had left the ship, found themselves completely separated from it. After the crevasses had frozen over, the crew regained the ship, and continued observations until Christmas eve, when the ice floes again put themselves in motion, crashing against each other with such force that the *Varna* was literally crushed. The crew escaped with safety, and with their documents, instruments, dogs and sledges, took refuge on board the *Dijmphnu*, the solid construction of which enabled it to resist the movement of the ice.

Here they were compelled to remain until August 1st, when, as the *Dijmphna* had orders to spend a second winter in the Arctic, they made for the land by means of boats and sledges, and reached Waigatz island in three weeks. Here they fell in with the *Louise*, the *Nordenskjold* and the *Obi*, all sent in search of the *Varna*. All collections and papers were saved; and not one of the crew was lost, in spite of the hardships endured.

Africa.—*The Dunes of the Sahara.*—Not more than a ninth part of the surface of the Sahara is occupied by sand-dunes, the principal groups of which are in the north of that desert, and are those of Erg, in the Algerian Sahara, that of Iguidi, which

[1] This department is edited by W. N. Lockington, Philadelphia.

continues the Erg group to the south-west into Morocco, and that of Edeyen to the south-east of Erg. The Erg group extends from the 20° to 34° N. lat., and from 7° E. long., to 4° W. long. Erg alone is reckoned to occupy 12,000,000 hectares, or about 45,000 square miles, but the estimate is probably too large, as immense spaces within the area are free from dunes. The dunes are in some places piled into chains of sand mountains, which may reach several kilometers in width, and 500 to 600 feet in height. The true dune, when not piled on other dunes, is of uniform composition and regular form. The grains are usually less than a millimeter in diameter, and the shape of the dune is an elongated ellipse, with a concavity cut out of the leeward side. The sand, driven by the wind, climbs up the long gradual slope of the ellipse, and falls over the abrupt talus of the short concave side, which is bounded above by a sharp edge. A simple dune seldom exceeds sixty-five feet in height, but here and there one rises to more than two hundred feet.

The dunes occupy basins of Quaternary age, and have been formed by the disintegration of rocks of various ages. Disintegration proceeds less rapidly in a dry climate than in a wet one, but in the Sahara there is no vegetation to protect the surface, and the disintegrated material is never consolidated into soil. The chief causes of rock disintegration in the Sahara are the great difference of temperature, amounting often to 100° C., between the day and the night, and the action of wind-blown sand upon the rocks; chemical action and the infrequent rains may be added.

Comali-land.—The Geographical Society of Paris has recently published the results of the journey to the country of the Comalis, undertaken by M. Revoil in 1880. The region may be divided into three zones, the coast, where the towns are situated; the mountains, which are often calcareous and are identical in their stratification with those along the borders of the Red sea; and the interior plateau, inhabited by nomads with their flocks. The coast is chiefly a belt of sand, interrupted here and there by cliffs, and with a vegetation of acacias and a few other spiny shrubs with some shore plants. The interior is a series of great steppes, sometimes unrelieved by a shrub, and covered with a bed of blackish siliceous sand. These steppes are interrupted by immense pastures, affording subsistence to the numerous herds of oxen, sheep, goats, asses, horses and camels which constitute the only riches of the Comalis of the interior. Most of the streams are torrents of short course, and the only river worthy of the name is the Darror, which rises in the Hodaftemo mountains, runs south-west through a great valley, and falls into the Indian ocean. The valley would be a desert were it not for fine pastures here and there. The climate is temperate, yet rises to 34° C. on the coast, and to 45° or even 55° C. in the sun on the

interior plateau. In the mountains, at an elevation of over 5000 feet, it sometimes sinks to 11.5° C. The nomads of the steppes never cultivate the soil, are incurably lazy, wear only a piece of skin or simple cloth for clothing, and suffer greatly from phthisis and rheumatism, brought about by the action of the sudden changes of temperature on their undefended bodies. The other maladies most common among the Comalis are ophthalmia, cutaneous affections and scrofula. They have learned from the Arabs the use of a few herbs, but the universal remedies are bleeding and cauterization. Almost every native is tatooed all over with burns and scarifications.

The principal interest of this journey is ethnographic. The oldest human vestiges consist of heaps of shells mixed with bones of fishes and turtles, and strewn with flint implements of various kinds and remains of rude pottery. M. Revoil concludes that these remains must antedate 1700 B. C., and bases this opinion upon the fact that the Egyptian paintings of the tomb of Beikmara and those of the temple of Deir-el-Bahari show the inhabitants of Poum, that is, the Comalis, in the possession of metals. M. Revoil believes these mounds to be the work of the Ichthyophagi and Troglodytes of the old historians; while the more recent mounds of Hais, with their green and blue enameled pottery, are pronounced of the Ptolomean era; and the red pottery, amphoras, glass, etc., especially those found at Olok, seem to be of Roman age. M. Revoil believes that contact with the ancient Egyptians and the Ptolomean Greeks raised the Poum or Comali race to a comparatively high state of culture, which the Arab occupation has effaced.

Their arms are the bow and arrow, the lance, long and short, and the sabre and shield. Their cylindrical quiver greatly resembles that of the Egyptian infantry of the XVIIth dynasty. Spite of their debasement and their conversion to Islamism, their physiognomy, their habits, even their dress recall Egyptian, Greek or Roman more than Arab. The men wear still the *sagum arsinveticum*, while the women are attired in the *degou*, which is fastened at the shoulder, and resembles the *peplum* of the Greeks. At a wedding or a marriage they carry the *dairabad* or censer, in which they consume a resinous gum which gives out an odor like that of Russia leather.

GEOLOGY AND PALÆONTOLOGY.

M. JULES MARCOU ON THE GEOLOGY OF CALIFORNIA.—In a recent issue of the Bulletin of the French Geological Society, M. Marcou reviews the work done by American geologists, and adds thereto conclusions derived from his own observations. The "director of the Geological Survey," sometimes by name, at others by title, is, in this article, subjected to a series of severe castigations. After describing the syenitic granite, the contorted

gneiss, schists, argillites, slates, etc., and the contracted areas of mountain limestone and trias, M. Marcou comes to the band of fossiliferous Infra-lias, or Rhetian, which for more than a hundred miles exists in close contact with non-fossiliferous talcose or chloritic schists, quartzites, etc., and often in proximity to the veins of auriferous quartz. Here he capitalizes the words, "The gold is not Jurassic, but of the age of azoic rocks and of the most ancient graywackes." The metalliferous veins are never enclosed in the Rhetian, the close proximity of which to the gold-bearing quartz was the cause of the announcement, "made with much solemnity, that the gold of California was much more recent than had been believed, and that the Sierra Nevada and the greater part of the other sierras of the Great Basin were of the Jurassic epoch." Areas of three or four thousand square leagues have been, continues our author, made to move by longitudinal compression, and to rise high above the sea in order to account for the presence of two or three small tongues of Triassic rocks. After a description of the Lower Lias or Sinemurian of Plumas and Nevada counties, and the Crêtaceous to the south and west of Shasta City, he arrives at the Tertiary, commencing with the statement that there is no trace of Tertiary rocks in the Sierra Nevada properly so called. The Chico group, with Randall and Trask, and the Tejon, with Conrad and Heilprin, M. Marcou considers as certainly Eocene, with a fauna that certainly approaches the Suessonian and that of the London basin.

The Miocene, which forms all the groups of mountains between Los Angeles, Point Conception and the neighborhood of Fort Tejon, is one of the best developed formations, and both in its lithology and its fossils is the counterpart of the Miocene or Molasse of Switzerland, so much so, that natives of Switzerland and Swabia, without geological education, have remarked to M. Marcou, "Everything here is like our Molasse. Yet the Geological Survey of Whitney and Gabb says absolutely nothing of this resemblance. The *Flysch* of San Francisquito Pass, the *Nagelflüh* of San Fernando Pass and the *Molasse* of the Sierras Santa Monica and San Fernando escaped their notice." After a few words respecting the Pliocene of the deep valleys and parts of the coast, as shown at Los Angeies and San Diego, and mention of the vertebrate remains of the Rancho de Los Encinos, M. Marcou arrives at the Quaternary, where he again falls foul of Professor Whitney. "According to this savant, there was no Quaternary in California; he has seen nothing but Tertiary. More, he has divided the Quaternary of the Sierra Nevada into three groups which he calls Eocene! Miocene! Pliocene! His Eocene may be doubtful, but he is sure of his Miocene and Pliocene. Naturally, to arrive at this conclusion, he has put aside all lithological, stratigraphical and palæontological characters, just as he had done before for the Eocene of Chico in making it Cretaceous."

M. Marcou then proceeds to make merry over the Calaveras skull, which bore in its encrusting gravel a *Helix mormonum*, and which came from a shaft no one had seen. The existence of Quaternary man in California is not questioned by M. Marcou, the existence of mortars, hammers and other stone implements, together with some axes of obsidian and even some fragments of human bones, give incontestable proof of it, while the numerous remains of Elephas, Mastodon, Rhinoceros, Bos, Equus, Canis, Lama, etc., prove the Quaternary age of these remains.

The reference of this unauthenticated skull to the Tertiary age will, says our critic, "suffice to give an idea of the incorrectness and absolute lack of exactitude in observation of this economical geologist or specialist of mining statistics." "As for Tertiary man, there is absolutely no trace of him in all California, at least up to date."

M. Marcou has not yet finished. The glaciers of California are his next theme, and he laughs at the director and sub-director of the Geological Survey of California for marching for hours over the glaciers of Mt. Shasta without ever dreaming they were on a glacier, and at Professor Le Conte for bringing the northern ice-sheet over California.

The mountain ranges of California, according to M. Marcou, belong to the following ages:

I. Sierra Nevada, Tehachape and Sierra Madre (the mountains south of the union of the Coast range and Sierra) to the Azoic.

II. The Coast range, as far south as Point Conception and Santa Barbara, to the Eocene.

III. The Sierras of San Fernando and Santa Monica, to the Miocene.

IV. The hills of Los Angeles, to the end of the Pliocene.

V. The mountains east of the entrance of Cajon Pass, to the end of the Quaternary.

VI. The volcanic eruptions, to the commencement of the present age.

THE CRANIUM OF IGUANODON.—M. Dollo, in a fourth note on the dinosaurs of Bernissart (Bull. du Musée Royal d'Hist. Nat. de Belg., 1883), describes and figures the head of *Iguanodon bernissartensis*. Attached to the front of the mandible is a toothless unpaired bone which M. Dollo names the presymphysial, from its position anterior to the mandibular symphysis. This bone appears to have been observed by Hulke in Hypsilophodon, since that palæontologist mentions a "thin triangular bone bent into a trough-like form" and lying in front of a mandible of the latter saurian. Hulke suggests that this bone may be connected with the premaxilla, but M. Dollo states that in the seven skulls of *I. bernissartensis* studied by him, it was attached to the lower jaw, and that its presence in the upper jaw would render inexplicable

the relations of the facial bones to each other. Moreover the anterior angle of the presymphysial bone bears some crests or denticles of bone, which, had the bone been by any means forced away from a previous union with the premaxillary, must certainly have been broken off.

The coronoid process consists, in the order of their importance, of the dentary externally, the coronoid internally, and a vertical process of the articular posteriorly. It thus differs widely from that of the chelonians and lizards of the present age, in which it is formed of the coronoid element only, and from that of the ophidians, which is largely composed of the surangular, but approaches more nearly that of Hatteria, in which it is formed of coronoid and dentary. From all existing reptiles it differs in its position externally to the alveolar border and anterior to the end of the dentary series. The premaxillaries do not differ greatly in their structure from those of Hypsilophodon. The frontals do not form any part of the upper orbital border, from which they are separated by two supra-orbitals. These are borne upon the two pre-frontals, which are also thus excluded from the exterior upper border of the orbit. As a whole, the skull presents a far greater number of points of resemblance to Hatteria than to any other living reptile. Each ramus of the mandible bears twenty-one teeth in use, and numerous partially developed rows on the internal face; while each maxillary carries twenty-five fully-formed teeth. The vertebral column has ten cervical, eighteen dorso-lumbar, six sacral and fifty-one caudal vertebræ, eighty-five in all; while the ribs consist of nine cervical and seventeen dorsal pairs, as the atlas and last dorsal are without ribs. In an appendix M. Dollo compares Iguanodon with *Diclonius mirabilis*,[1] and finds that his "presymphysial" bone is identical with the "flat, thin and edentulous" dentary of Professor Cope.

Discovery of Tracks in the Jura-trias of Colorado.—Professor H. W. Parker, of Iowa College, has discovered some fifty animal footprints in the vicinity of Denver.

Of the slabs which he obtained one is about five feet long, and running across it diagonally are nine pairs of tracks, each two and a half inches long, and with a stride of nearly nine inches and a straddle of five inches. The peculiarity in respect to form is, that every track exhibits but one apparent digit, this ends with a claw, and in some of the tracks seems to be three-jointed. The ball of the foot is deeply impressed and round. Another slab gives five pairs of footprints, much larger, and singularly enough, part of each is rounded like the well known hoof-like sea-weeds. No hoofed animals lived then, and the straddle is very small in proportion to the size of the prints. All these are

[1] E. D. Cope, Amer. Nat., July, 1883, p. 774-7.

unmistakable tracks, in the judgment of Professor Parker, who, from long residence at Amherst, Mass., has become familiar with the thousands of footprints found in the Connecticut valley, and constituting the feature of the Amherst College museum.

In 1880, Mr. R. C. Hills, of this city, found a few Triassic tracks on the western slope of the Rocky mountains, and they are now in the museum of Yale College.—*Rocky Mountain News.*

LOCOMOTIVE APPENDAGES OF TRILOBITES.—In the autumn of 1882 the trilobite, *Asaphus megistos* (Fig. 1), was sent me for examination. In the delay of correspondence with palæontologists, fortunately no report was made, for in the spring of 1883, twelve months after finding the first specimen, the same party found the second, which proved to be the matrix of the ventral surface of the first specimen. It was found about one hundred meters from the point where the first was obtained.

About two-thirds of the cephalic shield is broken off. That part of the head anterior to a line drawn obliquely through the left eye to the middle of the pleura of the second thoracic somite on the right, is entirely wanting. With the head restored, the specimen would be about 18.5 centimeters (7⅜ inches) long; in width, 11.5 centimeters (about 4½ inches). On the ventral surface (Fig. 1) a broad median *groove* extends along the concavity of the thorax and abdomen. It begins at a point beneath the articulation of the head with the thorax, or in the posterior part of the area between the lobes of the hypostoma. Its length is 10.5 centimeters (4⅛ inches)—6.5 centimeters being the length of the thoracic, and four centimeters that of the abdominal portion of the groove. This specimen clearly demonstrates the *concavity* of the three principal divisions of Asaphus, a fact which Mr. Billings pointed out in 1864. The vertical distance from the dorsal surface of the head to a line in the plane of the external margins of the pleuræ is 2.5 centimeters (about one inch).

Directly beneath the eight somites of the thorax, *ten* pairs of jointed limbs are distinctly seen; the two anterior pairs of appendages are situated directly under the first two thoracic segments; but from the character of these appendages, as well as the relation of parts, these, while having the general appearance of organs of locomotion, yet were, no doubt, maxillipedes with the basal joints articulated to the body of the animal, near the point where the oral aperture certainly existed, and presumably they were differentiated to perform the function of mouth organs, and consequently should be considered as belonging to the cephalic division. The remaining eight pairs of legs are then directly referable to the eight thoracic somites. The number of joints in a limb cannot be definitely given from a study of these specimens; the basal joints are not preserved at the median groove.

Following the terminology of Milne-Edwards for the several

parts of the limb of a crustacean, the prominently-marked portion of these ambulatory limbs is undoubtedly the meropodite, which was in some cases two centimeters in length and quite large, with the mero-carpopodite articulation well pronounced, so as to leave a distinct, pit-like depression in the matrix. The several joints externally to that which is considered the meropodite can be distinguished by careful study of the several legs and the grooves and foveæ of the matrix. The carpopodite was about the length of the meropodite, but decidedly slender as compared with the latter. If there was any positive evidence to show that these were broad, lamellar appendages, adapted to swimming, then the slender joints external to the meropodite might be accounted for by supposing the edges were the portions visible. The propodite was about two-thirds the length of the carpopodite, and also appears to have been slender and slightly curved backward; the dactylopodites are not well preserved, yet sufficiently so to permit the conclusion that they were not chelate. The posterior pair of these thoracic appendages is directly beneath the posterior somite of the thorax. The meropodites of the two anterior pairs of appendages, as shown in Fig. 3, resemble the same joints in the thoracic limbs.

In examining the matrix, Fig. 3 *d*, where the left limb of the anterior pair is well preserved, it is seen to curve around the outer margin of the left lobe of the hypostoma, and, from the evidence which the surface presented when first examined, I am of the opinion that this limb was chelate. In removing the limestone so as to expose the left lobe of the hypostoma, and also establish the articulation of the claws, an accidental stroke destroyed the evidence of this direct connection, yet at the fracture the ends of two broken claws can yet be seen. At first I was disinclined to regard the distal extremity of this pair as chelate. Before attempting to remove the limestone, the surface clearly showed a conjunction of these parts. This condition could have been accounted for by supposing one limb to have been thrown over another. It was to clear up this point that the removal of the adhering material was made. If chelate, the claws were slender and of about equal size as in Limulus. As the hypostoma is frequently found in this limestone formation, it is to be hoped that these limbs will also be found, so as to definitely settle this point. On fitting the two specimens together, the ends of these supposed claws are seen at the fracture directly beneath the left eye. These specimens demonstrate that the thoracic appendages were well developed walking legs, extending nearly to the outer margins of the carapace. The exoskeleton of the limbs seems to have been somewhat different in character from the calcareous exoskeleton of the dorsal surface of the animal. At least, it was of such a character as not to preserve well the integrity of the parts in the process of fossilization. They could not have been soft and yielding,

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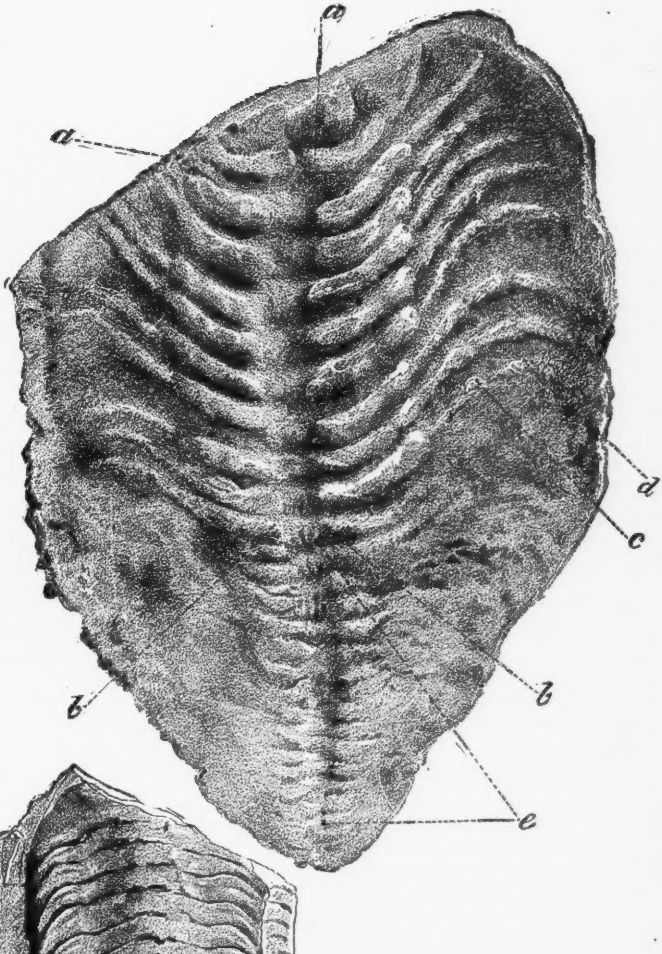
PLATE XXVI.

Fig. 1.



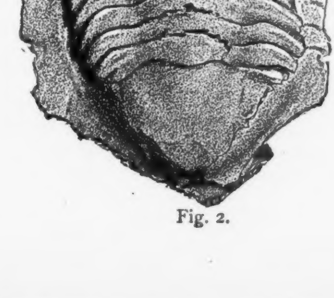
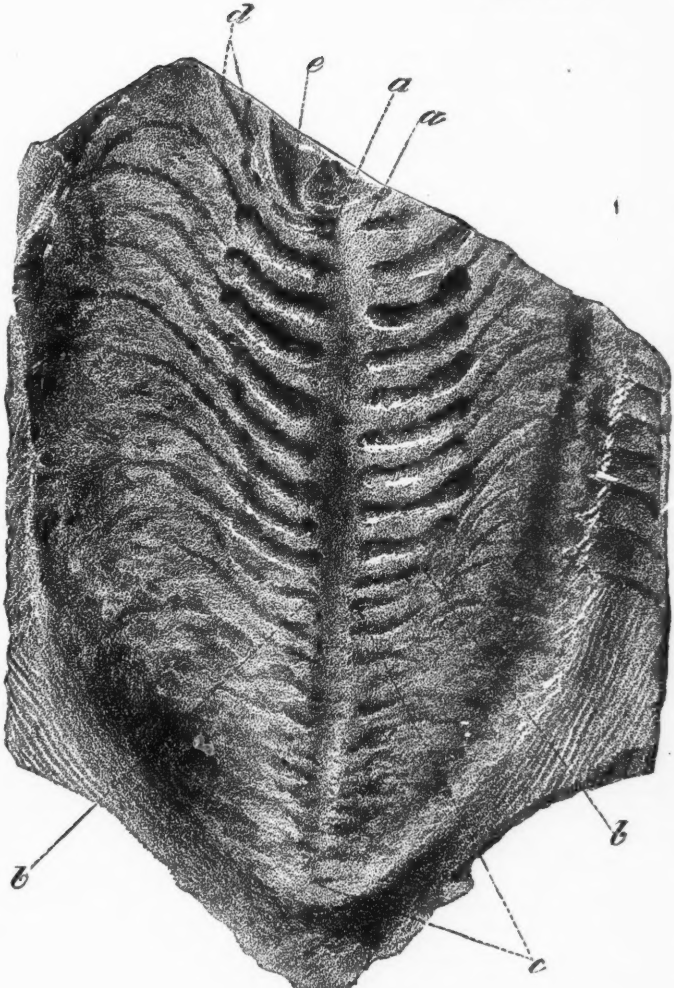


Fig. 2.

PLATE XXVII.



judging from the symmetry of the matrices of the meropodites, as well as from the general cylindrical character of limbs themselves.

On the ventral surface of the pygidium there are at least twelve (pairs of) appendages; posteriorly, an exact enumeration is impossible. The term *pairs* is used on account of the median groove, showing in the structures a bilobed character. This groove is continuous with the thoracic groove, and is somewhat narrower and more shallow than the latter. From an examination of the two specimens, these twelve or more appendages appear to be leaf-like, or foliaceous, and on each side of the median groove the direction was outward and somewhat forward. No doubt these appendages were branchial in function, and also adapted to swimming.

EXPLANATION OF PLATES XXVI AND XXVII.

FIG. 1.—Natural size. *a a*, meropodites of anterior pair of appendages—maxillipedes; *b b*, eighth pair of (thoracic) legs; *c*, articulation between carpopodite and propodite; *d*, articulation between propodite and dactylopodite; *e*, branchigerous organs beneath pygidium.

FIG. 2.—The specimens 1 and 3 fitted together, and reduced to nearly one-third nat. size.

FIG. 3.—*a a*, matrices of meropodites of anterior pair of appendages; *b b*, matrices of eighth pair of legs; *c*, branchigerous appendages; *d*, left maxillipede, probably cheiate; *e*, left lobe of hypostoma.

—*J. Mickleborough, Journ. Cincinnati Soc. Nat. Hist.*

GEOLOGICAL NOTES. — *Triassic and Permian.* — Among new Stegocephali lately described by Herr Credner from the Dyas of Saxony, are *Acanthostoma vorax*, *Melanerpeton spiniceps*, and *Discosaurus permianus*. The last is remarkable for the round disk-like plates, built up of concentric rings, that cover its body.

Cretaceous.—M. L. Dollo (Bull. du Mus. Roy. d'Hist. Nat. Belg.) describes some remains of dinosaurs from the Upper Cretaceous of Belgium. Two vertebræ from the Mæstricht beds may perhaps belong to the form described from the same beds by Professor Seeley. An ungual phalanx from Louzee is evidently that of a carnivorous dinosaur of about half the size of Megalosaurus, and less specialized than that saurian; while two singular teeth having crenulated borders as in Iguanodon, but differing from those of the latter in their antero-lateral compression and other details of form, as well as in the fineness of the serrations, are ascribed to a new genus and species, and named by M. Dollo *Craspedodon louzeensis.*

Tertiary.—In a recent issue of the *Geological Magazine*, Professor Owen gives a basal view of the skull of Thylacoleo, showing clearly the very small size of the space for the cranial cavity and the expansion and strength of the zygomatic arches.

MINERALOGY[1].

MINERALS OF THE CRYOLITE GROUP FROM COLORADO. — W. Cross and W. F. Hillebrand,[2] who have previously described a number of interesting species from the vicinity of Pike's Peak, have identified cryolite and several allied fluorides from the same region, and have given a very exhaustive account of their method of occurrence, physical and crystallographic characters, and chemical relations. Cryolite occurs in massive aggregates of crystalline individuals, and when fresh has often a delicate pink or rose color. As products of alteration there occur pachnolite, thomsenolite, gearksutite, prosopite and probably ralstonite. These all occur in a vein of white quartz, near the base of St. Peter's dome. Astrophyllite and altered columbite occur at the same locality. The cryolite is decomposed where it adjoins the quartz, and is replaced by a massive mixture of pachnolite and thomsenolite, which is sometimes so far decomposed as to produce a white powder-like kaolin, which, when wet, makes a thick mud or paste. This kaolin-like substance is shown to be gearksutite Under the microscope it is seen to consist of minute colorless needles. A chemical examination of the pachnolite, which occurs in distinct, colorless, transparent crystals upon the cryolite, proved that in chemical composition it was identical with thomsenolite. This result does not agree with that obtained by Groth and Brandl[3] in a recent investigation upon the fluorine minerals.

In another quartz vein about one-third of a mile distant from the first locality, there were found zircon, kaolin, etc., a greenish-yellow mica and fluorite. Adjoining the quartz was an irregular zone of purple or green fluorite, and next to this a mass of a colorless mineral with two distinct cleavage planes, rarely occurring in minute crystals. This has been shown to be *prosopite,* a mineral heretofore known only in connection with the tin-bearing veins of Altenberg, Saxony. Prosopite was also found in minute crystals upon altered pachnolite in the quartz veins first mentioned. The identification of this rare species is of much interest. The authors deserve much credit for the care and skill which they have applied to the study of the minerals in the neighborhood of Pike's Peak.

THE URANIUM MINERALS —Heinrich Baron von Foullon has published[4] an exhaustive paper on the decomposition products of uraninite, and on the chemical separation of uranium from lime and other substances, and comes to some important conclusions of interest to mineralogists. The uranium minerals examined are

[1] Edited by Professor H. CARVILL LEWIS, Academy of Natural Sciences, Philadelphia, to whom communications, papers for review, etc., should be sent.

[2] *Amer. Jour. Sc.*, Oct., 1883.

[3] Zeits. f. Kryst., VII.

[4] Jahrbuch d. K. K. Geolog. Reichsanstalt, 1883, B. XXXIII, p. 1.

from both European and American localities, special attention, however, being given to the gummite and associated minerals from North Carolina. After a discussion of the various analyses made by different chemists, and an examination of the homogeneity of the specimens analyzed, it is concluded that the minerals known as eliasite, pittinite and coracite are mere varieties of gummite, not entitled to distinctive names, and that uranotil is identical with uranophane, and should therefore be dropped as a mineral species.

Both gummite and uranophane result from the alteration of uraninite (pechurane), and therefore very properly follow that species in the classification of some authors.

Minerals from Lehigh and Berks counties, Pa. — E. F. Smith and D. B. Brunner[1] contribute a series of analyses of minerals which occur in Lehigh and Berks counties, Penna., and describe a nmber of new localities.

Allophane, occurs near Ballietsville, Lehigh county, in the form of white, mammilary, stalactitic incrustations upon iron ore. *Fluorite* is intimately mixed with the limestone about a mile and a half south-east of the above locality, presenting beautiful green, purple and pink colors. Perfect octahedra of deep purple color occur south of Emaus in the Lehigh mountains. *Zircon* was observed in minute crystals in quartz in Upper Milford township, Lehigh county. *Wavellite* from the same vicinity occurs in fine colorless, radiating nodules. Associated with it were clay-like nodules, sometimes showing a radiated structure, which have probably resulted from the alteration of wavellite. These appear to have no definite composition. *Corundum* in fine crystals, sometimes showing asterism, occurs in the same township. *Tourmaline*, *menaccanite* and *garnet* also occur here, and their analyses are given.

Other minerals from Lehigh county are *stilbite*, *pyrolusite* and *chloropal*, the latter being a soft yellowish green substance accompanying iron ore. The mineral is earthy and may be polished by friction.

In Berks county, new localities and analyses are given for *stilbite*, *deweylite*, *vesuvianite*, *titanite* and *brucite*. Vesuvianite and brucite were found at the now well-known mineral locality of Fritz island, near Reading. The latter mineral forms thin colorless laminæ in seams intersecting limestone.

Mineralogical Notes.—In the death of Professor J. Lawrence Smith, at Louisville, Ky., on October 12, American mineralogy loses one of its most eminent masters. His memoirs on corundum and emery, and his numerous physical and chemical investigations on meteorites, together with his many contributions to chemical mineralogy, have made his name well known to scientific

[1] *Amer. Chem. Journ.*, Sept., 1883.

men all over the world. In 1877 he described under the name of rogersite a mineral resulting from the alteration of samarskite. In the same year Daubrée, of Paris, named after him the mineral Lawrencite, a protochloride of iron first detected by Dr. Smith in meteorites. Dr. Smith has published in book form a collection of his memoirs of especial interest to mineralogists. He was one of the few American members of the Academy of Sciences of Paris.——At the American exhibition recently held in Boston, several States exhibited collections of minerals. North Carolina was especially well represented, making a large exhibit of beautiful and often rare species. Among the most noteworthy minerals were the following: *Gummite* in a mass weighing six and a half pounds; *uraninite* in masses of several pounds weight; crystals of *monazite*, *fergusonite* and *xenotime;* large masses of *allanite* and *samarskite*, one specimen of the latter weighing five pounds; crystals of *emerald* over five inches long; brilliant prisms and geniculations of *rutile; quartz* showing basal and other rare planes; beautiful crystals of spodumene, beryl, etc.——The rare mineral *hörnesite*, a hydrous arseniate of magnesia, has probably been identified by M. E. Bertrand accompanying nagyagite from Nagyag, Trannsylvania. The crystals of hörnesite are of a pale rose color, have a talcose cleavage and are quite soft.——According to the newspapers, "Missouri is said to have a new mineral, adamscolite, that cuts steel."——What was probably one of the richest finds of gold ever made in this country at one time, was discovered recently in Amador county, Cal., according to a paper published there, which says a pocket of quartz, found less than 100 feet below the surface, and containing about two tons in quantity, yielded from $75,000 to $100,000. Much of the quartz, it is represented, consisted of what were virtually chunks of gold.——Tin ore is reported to occur in Rockbridge county, Virginia. A vein of cassiterite, several inches in thickness, runs nearly east and west through a gneiss containing large crystals of feldspar with mica and quartz.

BOTANY.[1]

A NEW SPECIES OF INSECT-DESTROYING FUNGUS (see AMER. NAT., Vol. XV, p. 52).

Entomopthora calopteni, n. sp.—I. Empusa stage, not seen.

II. Tarichium stage: Oöspores globular, or from pressure somewhat irregular in outline, colorless, 36 to 39μ. in diameter; walls thick (4μ.), colorless, smooth; protoplasm granular, often as if composed of many small cells, often with a large round vacuole.

Occurring as a clay-colored mass in the body cavity and femora of *Caloptenus differentialis.* Ames. Iowa, Aug. and Sept., 1883.

This is much like the species described by Peck (31st Report

[1] Edited by PROF. C. E. BESSEY, Ames, Iowa.

N. Y. State Museum, p. 44) as infesting the seventeen-year Cicada, but the oöspores in the latter are much smaller, being but 1.6 to 2μ., and in one case 3.8 to 5μ. The same fungus was described briefly by Leidy (Smithsonian Contrib., Vol. v, Art. 2, 1851), who gave the size of the spores as 9 to 18μ. long by 7 to 11μ. wide. The great difference in size between the spores in the species infesting Caloptenus and those in Cicada shows them to be distinct.—*C. E. Bessey.*

NOTES ON GYMNOSPORANGIUM AND RŒSTELIA.—In my orchard is a row of red cedars (*Juniperus virginiana*) running east and west. At a distance of sixteen feet north of this row of cedars is a row of apple trees, and at distances of sixteen and thirty-two feet on the south side of the cedars are also rows of apple trees. For eight or ten years now, in the latter part of May, the cedars are heavily laden with *Podisoma macropus* and *Gymnosporangium clavipes*, and in the early days of June when these fungi have begun to dry up, the leaves of the apple trees standing on each side begin to show the spermogonia of Rœstelia; but it is always noticeable that the apple trees are not all affected to the same extent. For instance, on a tree of the variety known here as Fallawater, and standing in the row of trees north of the cedars, almost every leaf is invariably spotted with spermogonia, and later in the season, in August, is literally loaded with Rœstelia (N. A. F. 1086. d.). Next to this tree stands one of the variety known as Summer Sweet. Part of the leaves on this tree show the spermogonia in the spring but never produce the Rœstelia. Next stands a Baldwin. This, like the Fallawater, shows an abundance of the spermogonia, and later of the Rœstelia. On the south side of the cedars the first row of trees is of the variety called Yorkshire Russett (the trees imported from England). These trees all show spermogonia in the spring, but never mature any Rœstelia. In the next row south are several varieties of apples, among which the English Russett shows the greatest abundance of spermogonia, and matures a few imperfect specimens of Rœstelia. From the above statement it will be seen that all the apple trees, even those standing at the same distance from the cedars, are not equally affected, and it is to be noted that those which are the most affected are all varieties which do not flourish in this locality, among which notably are the Baldwin and English Russett. This seems to indicate that an enfeebled condition of growth in a tree, renders such a tree more liable to the attacks of the parasitic fungi mentioned, and this may have a direct bearing on the artificial culture of Rœstelia, for although this has not, so far as I know, been demonstrated by actual experiment, it is altogether probable that seedlings raised from apples grown on a tree which annually bears a crop of Rœstelia, would be more liable to the attacks of this fungus than seedlings raised from apples grown on trees not so affected. I am led to

suspect this the more from having the past winter raised some seedling apple trees in a flower pot in the house, and from my utter failure to produce even spermogonia on these seedlings, although at the proper time last spring I placed fresh spores of Gymnosporangium on their leaves. In order to test this matter more fully I have saved seeds from apples grown on the *Baldwin*, which, as stated, was badly affected with Rœstelia, and from apples grown on a tree next to it which was unaffected with Rœstelia, in order to ascertain, if possible, whether the seedlings from these two trees will show any difference in their susceptibility to receive the inoculation of the Gymnosporangium spores.—*J. B. Ellis, Newfield, N. J., Oct., 1883.*

The Structure of the Cell-wall in the Cotyledonary Starch-cells of the Lima Bean.—Several years since, while studying in the microscopical laboratory of the University at Lewisburg, Pa., I undertook a thorough study of the seed of the Lima bean (*Phaseolus lunatus*). Among other things of interest I noticed a peculiarity in the structure of the walls of the cotyledonary starch-cells such as I have never seen noted in any work on structural botany. The following is an abstract from my notes:

If the contents of the large cells (starch-cells of cotyledon), or any except the procambium and epidermal cells, be removed, the end of the cell presents a very peculiar appearance (taken in very thin section from alcohol eighty per cent menstruum).

It seems to be perforated with holes (Fig. B), often so numerous and large as to give to the wall the appearance of lace-work or delicate net-work. The cause of this phenomenon for a long time eluded discovery. The transverse section of the cell-wall showed not the slightest evidence of perforation, and no very great difference in thickness in the various parts, the average thickness being about .0788$^{mm.}$ But by carefully changing the focus the middle lamella, which with good light may be readily distinguished, is seen to vary very much in thickness at different points, closely resembling a string of beads considerably separated from each other; also where the middle lamella is thickest the outer lamellæ become thinner (Fig. C). Now the central portion of the wall contains more moisture than the outer lamellæ, and would differ greatly in its refractive power from them; this difference being increased by their reciprocal relations of thickness, hence this might afford an explanation for the peculiar appearance. Moreover, it only occurs in the central portion of the cell, which may be due to absence of the efficient cause in the other parts, or to the interference of double walls at intercellular spaces which were quite large.

The observations were made with a Beck's "National," ⅛ inch objective; B eye-piece, with the tube of the microscope extended,

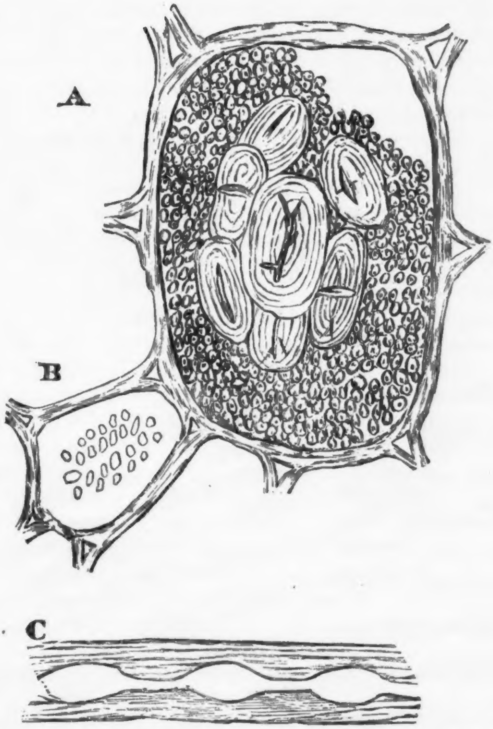


FIG. A.—A cotyledonary cell containing starch and aleurone. FIG. B.—A cell from which the starch and aleurone have been removed, showing the appearance of cell-wall when seen in front view. FIG. C.—Structure of the wall in transverse section. (All the figures much magnified.)

and required most favorable position.—*Wm. Frear, Washington, D. C.*

NEW FLORIDA FUNGI. I.—*Aylographum quercinum* E. & M.—Perithecia scattered over the upper surface of the leaf, flattened, linear, often branched, opening by a longitudinal fissure along the center, 180–350 x 90–100μ., bordered with a fringe of brown, creeping hyphæ; asci ovate or subglobose, 20–30 x 18–20μ., abruptly and briefly stipitate; paraphyses none; sporidia crowded, obovate, two-celled, 10–14 x 6–7½μ. Differs from *A. vagum* Desm., and *A. sarmentorum* De Not., in its larger perithecia and sporidia. On leaves of *Quercus virens.*

Peziza (Mollisia) gelatinosa E. & M.—Sessile, gelatinous, hyaline with a tinge of rose color, $\frac{1}{4}^{mm}$ diam., convex, immarginate; asci obovate, 35–40 x 15–20μ.; paraphyses recurved and bent with a small knob-like swelling at the tip; sporidia 2–3 seriate,

fusiform, subhyaline; endochrome three times divided, 12–16 × 3–3½µ., much as in *H. castaneum* S. & E. On living leaves of *Persea palustris*, on patches of sterile mycelium of some Meliola.

Helotium maculosum E. & M.—Orbicular sessile, ⅛mm diam., plane or convex when fresh, concave when dry, disk dull, dirty flesh-color, darker outside with a few brown bristle-like, faintly-septate hairs arising from near the base; asci oblong-clavate, 55 × 12µ.; paraphyses rather stout; sporidia biseriate, broad fusiform, endochrome three times divided, 16–20 × 4–5µ. Differs from *H. castaneum* S. & E., in its duller color, bristle-like hairs and larger, 3-septate sporidia. On pale brown spots on living leaves of *Persea palustris*.

Meliola manca E. & M.—Mostly epiphyllous in small (1–2mm) suborbicular patches thickly scattered over the leaf and often subconfluent. Prostrate hyphæ with opposite branches and short, obovate, alternate, obtuse branchlets (haustoria?); erect hyphæ (bristles) none; perithecia subglobose, about 200µ. diam., collapsing, papillose, appendages none; asci ovate-oblong, mostly two-spored; sporidia oblong-cylindrical, brown, 3-septate, constricted at the septa, slightly curved and a little flattened, 35–43 × 12–15µ. On living leaves of *Myrica cerifera*.

Meliola cryptocarpa E. & M. — Mostly epiphyllous, forming small (2–4mm) patches thickly scattered over the leaf and often confluent. Prostrate hyphæ pale brownish, irregularly branched and septate, bearing numerous oblong-fusiform, pale brown, 3–4 septate conidia, 30–40 × 5–9µ., obtuse or acute above and contracted below into a short stipe; erect bristles, abundant, simple, multiseptate, black, tips entire and paler; perithecia not abundant, often sterile, small, collapsing, surrounded at base with a few diverging brown septate appendages which, like the bristles of the hyphæ, are more or less crisped or undulate above; asci oblong-ovate, containing eight oblong or oblong clavate or narrowly elliptical, crowded, brown, 3–5 septate, 30–50 × 10–12µ. sporidia. On leaves of *Gordonia lasianthus*.

Asterina delitescens E. & M.—Mycelium thin, black, epiphyllous, forming small (2-4mm) orbicular patches, composed of much branched, closely appressed hyphæ on which are seated the flattened crowded (75–100µ.) perithecia of radiating-cellulose structure; asci 30–35 × 18–22µ.; obovate or subglobose; sporidia pale yellowish, 2-celled, ovate-oblong, 15–18 × 6–7µ. On living leaves of *Persea palustris*.

Outwardly this has much the same appearance as *A. pelliculosa* Berk., but the specc. in Rav. F. Am., No. 75, have dark brown, strongly constricted sporidia 35 × 19µ. (16–20µ. long in Sacc. Syll.), and the mycelium is of a different character. *A. fimbriata* Kalch. & Cke., has the perithecia on small brown spots.

Asterina carnea E. & M.—Hypophyllous on a thin, black-

brown, subcrustose mycelium composed of closely appressed, subanastomosing brown hyphæ extending for the most part along the margin of the leaf or forming orbicular patches about $\frac{1}{2}^{cm}$ diam., on which are seated the crowded, small ($55-75\mu$.) subglobose (astomous ?) perithecia which are flesh-colored under the pocket lens and bright straw color under a higher power, and contain 4–8 obovate sessile asci $30-40 \times 22-35\mu$., with eight, ovate 2-celled sporidia $16-17 \times 7-8\mu$. almost exactly like those of the preceding species, having the endochrome divided into two distinct parts separated and surrounded by a hyaline border. On living leaves of *Persea palustris.—J. B. Ellis, Newfield, N. J., and Dr. Geo. Martin.*

Botanical Notes.— In the October *Overland Monthly*, Dr. Parry contributes an interesting article upon "Early Botanical Explorers of the Pacific coast." The greater part of the article is taken up with an account of the labors of David Douglas, extending from 1825 to 1834, in which year he met his tragic death. Briefer mention is made of Dr. Thomas Coulter (1831 to 1833), Thomas Nuttall (1834–6), Theodore Hartwig (1846), and Wm. Lobb (1850).——Strasburger concludes that impregnation (fertilization) is essentially a union of cell nuclei. The nucleus must then be regarded as the sexual organ of the cell. Is its presence in other than sexual cells, in complex plants, simply a persistence of a structure which is no longer of use? Has the division of labor in the community of cells, while resulting in the development of a few special sexual individuals, been accompanied by a suppression of sexuality in all the rest? Are ordinary cells (nonsexual cells) comparable to the "neuters" or workers in the bee colony?——A. P. Morgan continues his Mycologic Flora of the Miami valley in the Jour. Cin. Soc. Nat. Hist. Species of fourteen genera from Coprinus to Lenzites are described. Of these five are new to science, viz., *Coprinus squamosus*, *Hygrophorus lauræ*, *Russula incarnata*, *Marasmius fagineus* and *M. capillarus.* Excellent lithographs are given of the first and second.——Fascicle VI of Van Heurck's Synopsis des Diatomées de Belgique has lately been received. It completes the plates, which are now to be followed by a volume of text. There are 132 plates.——Henry Brooks, of Boston, has prepared sets of sections of woods arranged for instruction in schools. The sections are about 2 × 4 inches, and are neatly mounted between plates of mica. Three sections (one cross and two longitudinal) are given for each kind of wood, and these are thin enough to make their study with the naked eye, or with a low power, very easy and instructive. It is to be hoped that many schools will supply themselves with these sets.

ENTOMOLOGY.[1]

An Epidemic Disease of Caloptenus differentialis.[2]—On Aug. 26th of the present year I noticed numbers of this common locust hanging to the upper portions of various weeds in the attitude of life, but with their bodies falling to pieces and appearing in some cases as if they had been eaten into by birds.

A hasty examination of the bodies showed that the soft parts were entirely destroyed, but the body more or less filled with a pulverulent clay-colored mass. Suspecting some parasitic disease, I collected a number of specimens, and the following day made a microscopic examination of the body contents. This showed the substance to be composed of minute spherical bodies massed together in immense numbers, which were evidently one stage of some parasitic plant, and, as such, specimens were referred to Professor Bessey, who pronounced them Entomophthora of a species hitherto unknown. He has kindly described the species under the name *Entomophthora calopteni*, and his description will appear in this number of the Naturalist.

Subsequent observation showed the epidemic to be quite widespread in this locality, but especially prevalent in the low land adjoining a creek which runs about a mile east of the college.

Two or three weeks after first noticing them I could find scarcely a living specimen of this species of locust in that locality, though in the college garden they were still plenty, and most of them apparently quite healthy.

Although the species of locust named is the one which seems particularly affected, I have found *Caloptenus femur-rubrum* evidently attacked by the same disease, but no microscopic examination of the body contents was made.

The early stages of the disease have not been noted with certainty as yet, and so far as I can judge they are not marked unless it be by a sluggishness of the insect. The locusts seem invariably to climb to the upper portion of some tall weed or stem of grass. They fix themselves firmly by legs and claws to the plant so that they remain after death until broken to pieces, when they fall away part by part.

In some specimens noted, which were apparently but recently dead, the body contained a blackish fluid substance, but this must very quickly be replaced, if it always occurs, by the mealy mass. This mass, however, remains moist for some days, but finally, if kept in a dry place, becomes entirely hard, the oöspores retaining their globular form and original size unaltered.

Our knowledge of this parasite is still too meager to draw any positive conclusions concerning its economic value, or to say whether it can be controlled and used against such destructive

[1] This department is edited by Prof. C. V. Riley, Washington, D. C., to whom communications, books for notice, etc., should be sent.

[2] Read before the Iowa Academy of Science, Sept. 27, 1883.

insects as the different species of locust; points which will be of special interest in case of another invasion of the Rocky Mountain locust, though certain species of our native locusts are probably no less important economically if their abundance and constant work be taken into consideration.

The oöspores could easily be distributed in localities where the disease occurs, and thus the disease could doubtless be introduced in localities not previously infected, and once introduced it would, like other epidemic diseases, under proper conditions propagate itself. Further study is necessary to establish these points and to determine what methods, if any, are to be adopted for the cultivation of the disease.—*Herbert Osborn, Agricultural College, Ames, Iowa.*

[We strongly suspect that the Entomophthora is a result rather than a cause of disease and debility in this case. The death of species of Calopteni, as of other Orthoptera, in the positions and with all the conditions mentioned by Professor Osborn, is of not infrequent occurrence in the Mississippi valley. We have often witnessed it, and have briefly referred to it in the 7th Mo. Entomological report, p. 180. Our experience has been, however, that the insects ascend the plants to die, after having been brought to the point of death by either Sarcophaga or Tachina larvæ, chiefly the former. At the time the maggots leave the locust the body of this last contains chiefly the decomposing "blackish fluid" alluded to, and this doubtless offers an inviting nidus to the spores of the Entomophthora. The general appearance of the pulverulent mass of spores is very similar to that of *Massospora cicadina* Peck, affecting Cicada when debilitated (31st Rep. N. Y. St. Mus. Nat. Hist., p. 44, 1879).—*C. V. R.*]

Occurrence of a Stratiomys Larva in Sea-water.—I send herewith rough sketches of a salt-water grub found by me on the 28th of July, beneath a bundle of sea-wrack or Zostera—popularly known as eel-grass—on the sea-beach at the north end of Plum island, near the mouth of the Merrimac river. I never saw a grub that could stand the washings of the sea before, and I was surprised by its habitat as well as its size. I picked up the eel-grass and the grub, and kept it in a box alive for three days, when a child got the box and I lost the prize. I believe it had attained its growth, and I regretted that its transformations could not be witnessed. Fortunately, fearing lest the grub might disappoint me, I measured and sketched the maggot, which was black and white. The head was not larger than the end of a cambric needle.—*A. W. Pearson, Norwich, Conn.*

[The sketch is evidently that of the larva of a species of Stratiomys, a fly typical of the dipterous family Stratiomyidæ. This is the first time the larva has occurred in sea-water, so far as we are aware. Similar larvæ have occurred in a hot spring in Colorado (American Naturalist, xvi, p. 599), also in Borax lake,

California (*American Journal of Science*, Feb., 1871, p. 102).—*A. S. P.*]

Some recent Discoveries in reference to Phylloxera.[1]—Every new fact in the life-history of the insects of this genus has an exceptional interest because of its bearing on the destructive grape-vine Phylloxera. The genus is most largely represented in this country by a number of gall-making species on our different hickories, and the full annual life-cycle of none of them has hitherto been traced. The galls are produced, for the most part, in early spring; the winged females issue therefrom in early summer; and thenceforth, for the remainder of the year, the whereabouts of the insect has been a mystery. The author has for several years endeavored to solve the mystery, and at last the stem-mother (the founder of the gall), the winged agamic females (issue of the stem-mother), the eggs (of two sizes) from these winged females, the sexed individuals from these eggs, and the single impregnated egg from the true female, have been traced in several species. There is some evidence, though not yet absolutely conclusive, that this impregnated egg hatches exceptionally the same season; also, of a summer, root-inhabiting life. In *Phylloxera spinosa*, which forms a large roseate somewhat spinose gall on *Carya alba*, and which has been most closely studied, the impregnated egg is laid in all sorts of crevices upon the twigs and bark and in the old galls, in which last case they fall to the ground.

Up to this time they have remained unhatched, and will in all probability not hatch till next spring, thus corresponding to the "winter egg" of the grape Phylloxera.

Coleoptera infesting Prickly Ash.—In his "Notes on Insects bred from Prickly Ash" (Trans. Amer. Ent. Soc., II, p. VIII), Dr. Shimer states that "among the Coleoptera obtained by beating the prickly ash bushes, I observe numerous specimens of a small gray snout-beetle, an undescribed species of Centrinus." The species referred to is undoubtedly *Zygobaris conspersa*, described by Dr. Le Conte in the Rhynchophora of N. A., p. 318, and the seven typical specimens were in all probability given to Dr. Le Conte by Shimer, and not, as stated (*l. c.*), by Walsh. *Z. conspersa* is, in my experience, peculiar to Xanthoxylon, but by no means occurs wherever this tree occurs. I have thus far failed to find the earlier states of the species, but I have no doubt that the small elongated scars occasionally to be seen on the smaller branches and which resemble those so frequently caused by Ampeloglypter on Ampelopsis, are the work of the Zygobaris.

Of the other species mentioned by Shimer in connection with prickly ash, only *Micracis suturalis* seems to be confined to that tree. His *Liopus xanthoxyli* bores in dead and dying wood of all

[1] Abstract of a paper by C. V. Riley, read before the A. A. A. S. at Minneapolis.

sorts of deciduous trees, and the two other species, *Læmophlœus adustus* and *Sacium fasciatum*, are also not confined to Xanthoxylum.

The worst enemies of the tree are *Trirhabda tomentosa* and the larva of *Papilio cresphontes* which, usually working in company, not unfrequently defoliate large groves.—*E. A. Schwarz.*

The Growth of Insect Eggs.—Dr. J. A. Osborne, of Milford, Eng., has an interesting article (Hardwicke's *Science Gossip*, Oct., 1883, p. 225) on growth in the eggs of insects. He attributes it solely to moisture. The most remarkable instance we know of is that of the eggs of our katydids, especially of *Phaneroptera curvicauda* (see 6th Mo. Ent. Rep., p. 165). Here the egg remains so flat between the cuticles of the edge of a dried leaf that it produces no swelling; yet before hatching it becomes cylindrical, even where the dry leaf is sheltered from dews and rains. Egg growth is usually great in proportion as the shell is delicate, and can generally be explained by endosmosis of moisture surrounding it; but here the shell is tough and can get no moisture beyond what is in the atmosphere, and there would seem to be an inherent swelling power consectaneous with embryological development.—*C. V. R.*

Protective device employed by a Glaucopid Caterpillar.—It is well known that many caterpillars, *e. g.*, those of the Arctiidæ, interweave their prickly hairs with their cocoons, thus not only rendering the latter stronger and thicker, but also furnishing a kind of protection in those species in which the hairs have an urticating power. A quite novel and very ingenious method of utilizing its hair for the protection of the chrysalis is that employed by the larva of *Eunomia eagrus*, as described and figured by Dr. Fritz Müller, in *Kosmos*, Vol. vi, p. 449. Around the slender twig to which it intends to fasten its chrysalis, the larva constructs from its hairs, before and behind itself, a series of whorls, about six in number, the hairs in each whorl being vertically and very densely fastened to the twig. The inside whorls are so fastened that they incline over the head and tail ends of the pupa. Between these two formidable rows of palisades the pupa rests safe from the attacks of any small and unwinged enemy.

Saw-fly Larvæ on the Quince.—Mr. J. A. Lintner, in the *Country Gentleman*, October 4, 1883, describes a slug-worm found by a correspondent injuring the leaves of his quince trees, and calls for identification of the same. There cannot be much doubt that the species is the common *Selandria (Eriocampa) cerasi* of Peck, well known to occur on apple, pear and cherry. Almost all insects that attack the pear will also attack the quince.

Entomology in New York.—Mr. Lintner has favored us with an advance copy of his first report (for the year 1881) as State

entomologist of New York,[1] and we have had much pleasure in its perusal. It is one of the best entomological reports published in this country. There is much to commend, not only in the matter itself and the great care with which every opinion given has been considered, but also in the scarcely less important details of arrangement of material; in the completeness of the index and table of contents; in the excellent little bibliographical lists accompanying the consideration of each species, and in many other minor points.

The report opens with a forcible plea for entomological study, and this is followed by a summary of the progress made in economic entomology in the last twenty years, embracing a short account of the personal work of each of the leading entomologists, and reference to the chief entomographic collections. Fifty pages are then devoted to a consideration of the most prominent remedies and preventives against injurious species. This part of the work is in the nature of compilation, with little that is based on the author's experience or experiment, but it is admirably done, and will prove most useful to those for whom it is more particularly intended. After a few pages on classification, the consideration of specific insects begins.

The injurious insects treated of comprise, in the main, those species which have lately been prominent in the State of New York. They are grouped into their respective orders, and are as follows:

LEPIDOPTERA.—*Thyridopteryx ephemeræformis*, *Tolype laricis*, *Nephelodes violans*, *Gortyna nitela*, *Heliothis armiger*, *Crambus vulgivagellus*, *Cr. exsiccatus*, *Anarsia lineatella*, *Bucculatrix pomifoliella*, and *Coleophora malivorella*.

DIPTERA.—*Phorbia ceparum*, *Ph. cilicrura*, *Anthomyia brassicæ*, *A. radicum*, *A. raphani*, *A. zeæ*, *A. similis*, *Hylemyia deceptiva*, *Mallota posticata*, *Drosophila ampelophila*, *Meromyza americana*.

COLEOPTERA.—*Macrodactylus subspinosus*, *Crioceris asparagi*, *Phytonomus punctatus*, *Sphenophorus sculptilis*.

HEMIPTERA.—*Murgantia histrionica*, *Pœcilocapsus lineatus*, *Enchenopa binotata*.

These articles contain much original and valuable matter, while previous writings are used with discrimination and full credit.

The report closes with four appendices. Appendix A gives a digest list of the entomological papers of Dr. Fitch and an account of his entomological works, chiefly in connection with the State. Appendix B includes a list of 176 insects injurious to the apple tree. C contains reprinted descriptions of *Nisoniades nævius*, n. sp., *N. petronius*, n. sp., *N. somnus*, n. sp., *Eudamus electra*, n. sp.; notes upon *N. propertius*, *N. icelus*, *Eu. proteus* and *Eu nevada*, and also a short paper on the Life Duration of the Heterocera. D, miscellaneous addenda. A and B are most full and praiseworthy; C, while valuable, is not so germane, being already accessible to entomologists, for whom alone it has interest.

[1] First annual report on the Injurious and other Insects of the State of New York. By J. A. Lintner, State entomologist. Albany, 1882. (Issued Oct., 1883.)

Altogether the report shows such care, ability and conscientiousness, that the people of New York are to be congratulated on having so worthy a successor to Fitch.

The illustrations are from various sources, and for the most part duly credited; a few are original. The press-work and paper, while by no means first-class, are rather above the average for State documents.

FRUIT INSECTS IN CALIFORNIA.—In "Injurious Insects of the Orchard, Vineyard, etc." Mr. Matthew Cooke has given Californians a very serviceable little book.[1] Between two and three hundred species of injurious insects are considered, and, although the work is in part a compilation, many of the author's own observations in the matter of remedies are given. By means of an extensive correspondence with entomologists at the East, Mr. Cooke has reduced scientific errors to a minimum. The work is very copiously illustrated, containing 750 wood-cuts. As an economy of space the remedies—124 in all—are grouped at the end of the work, and referred to by number at the close of the consideration of each species. The book is another evidence of the newly-awakened interest in economic entomology on the Pacific slope. With the push and energy which characterize Californians, Mr. Cooke, seeing the need of such a work, has thrown it together in an amazingly short time, and disarms all serious criticism by disclaiming in the preface any pretension to science, and by showing that he was led to the study of insects by his business of manufacturing fruit-boxes.

DEATH OF DR. J. L. LECONTE.—Just as we go to press we learn with profound sorrow of the death of this distinguished coleopterist. The loss of no other individual could be felt more keenly by the entomologists of America. As a writer he had won the esteem of all, and his family has our sincerest sympathy.

ENTOMOLOGICAL NOTES.—Dr. Hagen publishes in connection with his "Beiträge zur Monographie der Psociden" (Stett. Ent. Zeit., 1883, 285–332), an interesting review of the history of the "death-watch."——W. F. Kirby, of the British Museum, hitherto well known for his work in lepidopterology, has begun the study of the Hymenoptera, and will doubtless prove a worthy follower of the late Frederick Smith.——It is stated by E. H. Miller, in the *American Agriculturist*, that *Macrodactylus subspinosus* prefers the flowers of *Deutzia scabra* to the grape vine.——Dr. Hermann Müller, whose death was announced last month, had, by his painstaking studies of insects in their relations to flowers, achieved

[1] Injurious Insects of the Orchard, Vineyard, Field, Garden, Conservatory, Household, Storehouse, Domestic Animals, etc., with remedies for extermination. By Matthew Cooke, late chief ex[illegible] horticultural officer of California. Sacramento (1883).

preëminence in this inviting field of research. He wrote much for some of the leading natural history periodicals, and his two chief works are "Die Befruchtung der Blumen durch Insecten" and "Alpenblumen; ihre Befruchtung durch Insecten."——At the meeting of the Academy of Science of Paris, September 17, M. J. Chatain gave a description of the olfactory organs which are found on the antennæ of *Vanessa io.*——The imports of raw silk at the ports of New York and San Francisco for the month of October, 1883, reached 2783 bales = $1,726,741. The imports of waste silk and pierced cocoons at same ports, amounted to 50 pkgs. = $14,282.

Economic Notes.—It seems that the Treaty of Berne, to which most of the European countries have assented and which prescribes certain regulations as to the transit of plants with a view of preventing the introduction of the grape Phylloxera, has worked satisfactorily, though Holland, Spain and Italy, which were not represented in the treaty, yet find great annoyance from the Phylloxera laws existing on the continent. It is stated in a recent number of the *Gardeners' Chronicle* that thousands of plant packages are lying on the German frontier awaiting instructions. ——Mr. A. J. Caywood, of Marlboro, N. Y., informs us that dry lime liberally and rapidly thrown over the foliage after rain has, in his experience this season, proved effectual against rose-bugs, which came in swarms. It costs fifteen to twenty cents per bushel at the kiln.——The Le Brun prize of 500 fr. and a gold medal, awarded by the Academy of Belles Lettres, Science and Arts of Lyons, every three years, for the most valuable improvement relating to the silk industry, was this year awarded to an American, Edward W. Sewell, Jr., for his automatic silk reel.

ZOÖLOGY.

A new Virgularian Actinozoon.[1]—*Radicipe pleurocristatus*, both genus and species, is based upon a peculiar Japanese form, and is described by Mr. Stearns in the Proc. U. S. Nat. Museum, July 27, 1883.[2] It differs from other Virgularians in the arrangement of the polyps, which occur in a single series along one edge of the obtusely quadrangular style, and in the termination of the basal end, which instead of being simple or falciform, as in the species heretofore described, is furcate and root-shaped, pointing to a relationship, and connecting the simple-stalked Virgularians with the sea-fans or Gorgonacea.

The paper also treats of the structure and habits of related forms, and gives a new habitat, the codfishing banks of the Shu-

[1] Description of a new genus and species of Alcyonoid polyp from Japanese waters, with remarks on the structure and habits of related forms, etc., by Robert E. C. Stearns, pp. 96–101.

[2] Also read at the Montreal meeting of the Am. Assoc. Adv. Science, Aug., 1882.

magin islands, Alaska, for the gigantic Virgularian, *Haliptera blakei*, previously described by the author.

OUR FRESH-WATER SPONGES.—It is just twenty years since the first extended synopsis of the fresh-water sponges was published by Dr. Bowerbank (Proc. Zoöl. Soc. London, Nov. 24, 1863) including descriptions of twenty-one species. In 1842, twenty-one years before, Dr. Johnston's "History of British Sponges, &c." described but two fresh-water forms under the names of *Spongilla lacustris* and *Spongilla fluviatilis.* These names had then long been applied to two supposable species, though no better line of distinction had been drawn between them than the differing localities in which they were believed to be generally found. In Johnston's work also the descriptions fail clearly to distinguish the species, and his illustrative figures appear to have both been taken from specimens of *Spongilla lacustris.* Three years earlier, however (1839), Meyen had pointed out an essential difference between them, independent of their locality and general form; and it is a curious fact that the name *S. lacustris* was finally attached to the sponge which, in this country at least, affects rapidly flowing streams, and *S. fluviatilis* to the one which prefers the still waters of our lakes and pools.

The difference (in the character of their statoblast spicules) observed by Meyen between these early known forms, as further studied by H. J. Carter, Esq., F.R.S., among the other representatives of this growing family, became the basis of a new classification by the latter ("History and Classification of the known species of Spongilla," *Ann. and Mag. of Nat. Hist.*, Feb., 1881); and this excellent monograph, covering about thirty recognized species, stands as our latest authority on the subject.

The labors of a few workers during the last four years have added two well marked genera and a dozen or more American species to this list, and commenced the accumulation of a mass of information as to their habits and distribution, that can hardly fail to prove of value.

However meager may be the number of species in European and other foreign waters, it is plain that in America these sponges exist in many varied forms which should be classified and described. The circular somewhat widely distributed during the past summer with a view to invite contributions of sponges from localities which the writer could not personally visit, has been, thus far, quite disappointing in its results. Some contributions, however, have been received from those zealous workers, Mr. Henry Mills, of Buffalo, and B. W. Thomas, of Chicago, and from Professor E. D. Cope, H. Allen, J. Gibbons Hunt, and a few others. The collection made by Professor J. G. Hunt from the waters of Moosehead lake in the State of Maine, is the finest, for the size and symmetry of its specimens, yet noticed. Some of the streams in the New England and Middle States have been

peeped into, but the waters of the South are yet unexplored, while those of the West are but meagerly represented.

A few suggestions, growing out of the experience of the writer during the past three or four years, may be useful in promoting further effort.

As a rule, though as usual with some exceptions, fresh-water sponges *growing exposed to the light* are green, from the inclusion of chlorophyl granules; but *all* sponges do not habitually expose themselves to the light, and the collector who merely gathers what may be seen as his boat glides over them, or as he walks along the bank of stream or pond, will miss some of the most interesting forms. Again, the size of a mass of sponge depends, other things being equal, upon the length of time it has colonized, so to speak, the particular location upon which it is found. It is believed, from the writer's observation, that the contents of a single statoblast will rarely develop in one year into a sponge of a size likely to attract attention, and at the end of the season it dies, the sarcode slime disappears, and in many, perhaps most cases, the majority of its skeleton spicules are washed away. Before dying, however, there will have been formed, within its meshes, from one to a dozen or more reproductive bodies—the statoblasts or winter eggs of the sponge—of which number we may presume that an average of half a dozen may withstand the chances of the following winter, and, germinating in the spring, their contents coalescing, will reclothe with a growth of sarcode the persistent spicules, and form others, so that the resultant mass will, at the end of the second year, be at least six times as large as its ancestor of the year before. Increasing year by year in something like this ratio, a few seasons of comparatively undisturbed growth, will give us a sponge several inches in diameter, which may be the product of hundreds or thousands of statoblasts.

In this part of the country, so far as observed in the limited experience of the writer, the only sponges likely to be found of large dimensions, are the American representatives of the two original European species, now known as *Spongilla lacustrioides* and *Meyenia fluviatilis*, and the equally widely distributed species discovered and named by Dr. Leidy in 1851, *Spongilla fragilis*. All of these, beginning their lives where floating statoblasts may have lodged, upon the under side of stones, submerged branches or timber, are there found to be colorless or of a light yellow tinge; but soon creeping around upon the edge and to the upper surface, assume a light and ultimately a dark-green color; the first species particularly and to a less degree the others, seeming to rejoice in the full sunlight.

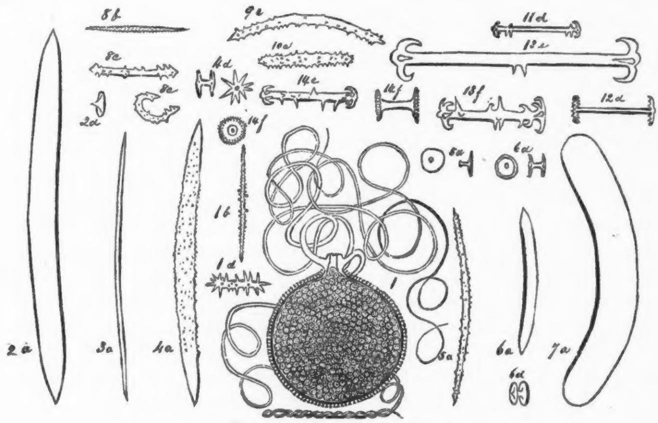
Though it is seldom safe to determine the species of a sponge from its general form, or from surface indications merely, it will

do to *guess* that a strongly-growing specimen with clearly self-sustained branches, belongs to the very variable species *S. lacustrioides.* If statoblasts are few or apparently wanting, the probabilities are increased. As between *M. fluviatilis* and *S. fragilis,* the statoblasts of the former, when present, are pretty evenly distributed through the interspaces of the skeleton spicules, while in the latter they occupy, primarily, a close pavement layer upon the supporting surface; and in *other* positions are generally grouped, three, four or more together, in a common envelope.

Other species are occasionally found of a more or less massive character, but the majority are filmy or encrusting, rarely exceeding a few lines in thickness, though sometimes extended over several square feet of surface. During the summer season their appearance is that of more or less slimy growths in their favorite localities upon the under, sometimes the upper side of stones, roots or rotten timbers, or on Sphagnum or other water plants. They have little color and generally bristle with minute spicules. By the latter part of September and later, the sarcode of many of these colonies and often a large portion of their skeleton framework, will have disappeared, leaving only detached groups of minute statoblasts adherent to the supporting substance, biding their time for a new growth the coming season. The successes of the writer have been largely found in his explorations of such localities, and in the collection and examination of this class of material. From a boat or while wading with rubber boots in shallow water, old timbers, stumps, &c., may be turned over, frequently revealing numbers of these groups for the delectation of the enthusiast. A secondary pleasure may be communicated and the species will be identified if specimens are sent to the undersigned. They should be clipped off and preserved in alcohol or allowed to dry thoroughly, otherwise they will soon mold.

Additional zest may be added to the search for these objects by the suggestion of a simple method of preparing them for microscopic examination. As, according to Carter's system, the classification largely depends upon the character of the spicules surrounding the statoblasts, his method of making these visible may be briefly stated: "Place a few of the statoblasts upon the center of a micro-slip, cover them with a drop of nitric acid and evaporate it off over a low flame. Repeat with a second or even a third drop when necessary to produce the required transparency. Remove the remaining acid by slowly trickling water over the inclined slide. Dry perfectly without using much heat, and apply balsam and a cover-glass. If the statoblasts now contain bubbles of air, these may generally be driven out by careful heating, when some of the most interesting and characteristic features of the sponge will be disclosed. A few of the characteristic forms of

spicules, &c., of American sponges, are shown in the following cut:



EXPLANATION OF FIGURE.

The accompanying figures are drawn from nature by the aid of the camera lucida, and represent the relative sizes and shapes of *like parts* of several sponges. The statosphere is magnified 35 times, the spicules of the skeleton, marked *a*, 150 times, all other figures 225 times.

1. *Carterius tenosperma*—Section of statosphere. (In the other genera these are without tendrils.) *b*, dermal or flesh spicule; *d*, birotulate spicule of outer coat of the statosphere.
2. *Parmula Batesii*—*a*, skeleton spicule; *d*, parmuliform spicule of statosphere.
3. *Spongilla montana*—*a*, skeleton spicule.
4. *Meyenia fluviatilis*—*a*, skel. spicule; *d*, birotulate stat. spic. and disk of rotule.
5. *Tubella Pennsylvanica*—*a*, skel. spic.; *d*, inequibirotulate spic. of statosphere and disk.
6. *Meyenia Leidii*—*a*, skel. spic.; *d*, birotulate stat. spic. and disk.
7. *Uruguaya corallioides*—*a*, skel. spic.
8. *Spongilla lacustrioides*—*b*, dermal spic.; *c*, stat. spic.
9. *Spongilla fragilis* var. *minuta*—*c*, stat. spic.
10. *Spongilla fragilis*, var. *Calumeti*—*c*, stat. spic.
11. *Meyenia crateriforma*—*d*, birot. stat. spic.
12. *Meyenia Everetti*—*d*, birot. stat. spic.
13. *Heteromeyenia argyrosperma*—*e. long*, *f*, *short*, birot. stat. spic.
14. *Heteromeyenia Ryderi*—*e*, long, *f*, short, birot. stat. spic.

—*Edward Potts, 228 S. Third street, Philad'a, Pa.*

PYRGULA NEVADENSIS.[1]—This is the name given to a new Hydrobiinoid mollusk inhabiting Pyramid and Walker's lakes in the Sierra Nevada mountains, by the author.

The species of Pyrgula heretofore described, are the types *P. helvetica* from Switzerland; *P. bicarinata*, France; *P. pyrenaica* from the Pyrenees, and *P. andicola* from the Andes of Bolivia.

[1] Description of a new Hydrobiinoid Gasteropod from the mountain lakes of the Sierra Nevada, with remarks on allied species and the physiographical features of said region, by Robert E. C. Stearns, in Proc. Phil. Acad. Nat. Sciences, 1883, pp. 171-176.

Its distribution hitherto, it will be seen, is Europe and South America; inhabiting fresh waters in mountainous regions, and it is interesting to notice that all the species of the genus as yet described occur in mountainous districts, an instance of correlation of form to external conditions.

Pyramid lake, although it receives the fresh water of the Truckee river, the outlet of that gem of lakes, Tahoo, is very strongly alkaline, and the water is not good for human use, although it can be used for a short period without much inconvenience.

The elevation of Pyramid lake is 4890 feet, and Walker's lake has an altitude of 3840 feet; the water is brackish.

These lakes are the remnants of the great Tertiary lake which covered this general region, and are the pockets or deeper depressions in the floor of the ancient lake.

Pyrgula nevadensis is a small shell, of five to six whorls, which are traversed spirally by a single strong keel or carina. It is white, smooth and glossy, and measures eighteen-hundredths of an inch in length by about half as much in breadth. It occurs also in a calcareous deposit with Pompholyx, another curious form, as well as in the dredgings.

Sexual Characters of Limulus.—It has often been puzzling to account for the fact that no cast-off shells of the Limulus, bearing the characteristic modified claw of the male, could be found along the sea-coast, at least I have never been able to find one, while the shells of what are generally supposed to be the young female are very abundant. During the past five years I have examined at least one thousand specimens along the shores of Long Island sound, about New Haven, and Vineyard sound, at one time collecting over one hundred during a single afternoon at Savin Rock, for the National Museum; and among all of these not a single specimen with the modified claw was found.

Good naturalists have told me that they have found them, but it is very possible that if they had examined carefully it would have resulted as it has with me in a large number of cases, viz., that they were dead animals and not cast-off skins.

At first thought it appeared that the males must be exceedingly few in number compared with the females, but this was found to be incorrect, as the living and dead males are often found, perhaps quite as often as the grown females.

During the past summer, in our shore trips from the U. S. Fish Commission laboratory at Woods Holl, Mass., I collected a large number of cast-off shells of the Limulus, also a few small living specimens, none of which possessed the modified claw of the male. (Fig. 1 B shows the well-known claw of the male, and A that of the female, both natural size.)

Upon further examination it was found that the genital openings, located on the under side of first pair of abdominal appen-

dages, are a sure distinguishing character of the sexes, even in

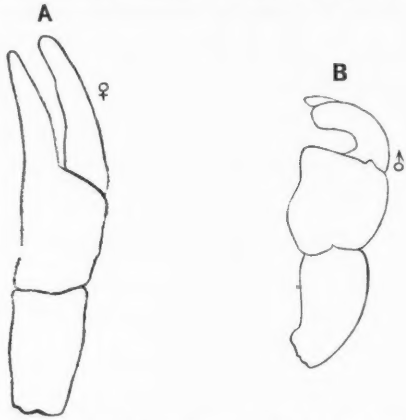


FIG. 1.—A, female, and B corresponding male claw of Limulus.

the very youngest. (Fig. 2 A represents those of the female, and B those of the male, both natural size.)

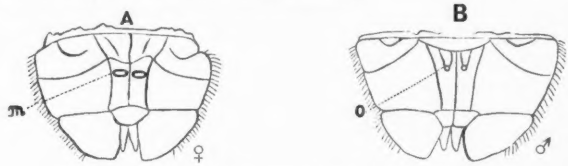


FIG. 2.—First Abdominal feet of male and female Limulus.

As here represented the openings of the oviduct in the female are transverse slits (Fig. 2 *m*), while the genital openings of the male (Fig. 2 *o*) are two papillæ with circular openings at the ends.

Of thirty-five exuvia and living specimens, varying from one to four inches in diameter, which were examined and the record kept, seventeen were males and eighteen were females, while none of them possessed the modified claw of Fig. 1 B, there being no essential difference in the hand and opposable thumb of the male and female.

These facts show that the male Limulus, while young, has the claws of the second pair of thoracic appendages like those of the female, and does not take on this modified form till well grown, and further, that it is possible that he never sheds his shell after this modified claw is acquired, because, as stated above, of over one thousand specimens examined, not a single specimen possessing this character was found. Further, we are led to believe that large Limuli rarely, possibly never, shed, because among all those examined, there were no large exuvia.

Of the living and dead specimens examined, the females were the largest, some measuring ten or twelve inches, and occasionally even more, across the carapax, and the males eight to ten inches in width. And the carapax of these large animals is usually overgrown with algæ and appear rusty and aged, while those of the small and medium sized Limuli are bright and clean, apparently kept so by their frequent shedding, but just how often this takes place is not definitely known. Doubtless they shed several times during the first year after hatching, for we have all stages, from the egg up through the tailless forms to the perfectly-formed Limulus, and all these certainly belong to the young of this year.

The increase in size at the time of shedding is remarkable. At the laboratory of the U. S. Fish Commission, at Woods Holl, Mass., during the summer of 1882, I found a small Limulus and placed it in an aquarium, and the next day found that it had shed during the night. It did not occur to me to make measurements of the exuvia and young animal till after they had been placed in alcohol, hence the results are not so reliable as some measurements made of fresh specimens at Woods Holl, this summer, by Professor S. I. Smith.

The first was reared by Mr. Bruner, and, as we supposed, was the second molt after hatching, and the second was of my own rearing, and was the third molt; the third are the measurements secured by myself a year ago.

No. 1. Aug. 3, 1883.

	Exuvia.	Young.
Entire length	4.0mm	7.1mm
Length of carapax	2.0 "	3.1 "
Breadth of carapax	3.5 "	5 4 "
Breadth of abdomen	2.7 "	4.0 "
Breadth between eyes	2.5 "	3.2 "
Length of tail	0 2 "	1.6 "

No. 2. Aug. 20, 1883.

	Exuvia.	Young.
Entire length	7.0mm	10.5mm
Length of carapax	3.0 "	4.2 "
Breadth of carapax	5.5 "	7.5 "
Breadth of abdomen	3.9 "	5.1 "
Breadth between eyes	3.3 "	4.0 "
Length of tail	1.8 "	3.4 "

No. 3. Aug. 26, 1882.

	Exuvia.	Young.
Entire length	29.0mm	40.0mm
Length of carapax	11.5 "	20.0 "
Breadth of carapax	17.5 "	22.5 "
Breadth of abdomen	13.2 "	16.5 "
Breadth between eyes	10.0 "	13.5 "
Length of tail	10.1 "	17.2 "

—*B. F. Koons, Storrs Agricultural School, Mansfield, Conn., Oct. 9, 1883.*

A NEW SNAKE FROM NEW MEXICO.—*Atomarchus multimaculatus*, gen. et sp. nov. Group Homalopsinæ, related to Tropidonotus.

Char. Gen.—Teeth isodont; anal scute entire; three internasal, and two nasal plates; loreal present; scales carinate, poreless.

Char. Specif.—Scales in twenty-one rows, all keeled excepting the inferior one. Superior labials eight, all low and rather long, the orbit bounded by the fourth, and cut off from the fifth by the inferior postocular. Loreal low, much longer than high. Preoculars two, both subquadrate; the superior the larger; the inferior resting on the fourth superior labial. Postoculars three, the median the smallest (the apex of the inferior cut off to form a fourth on one side). Temporals 1–3, the anterior large, bounding the sixth and seventh labials above. Rostral not prominent, wider than deep, truncate above. Internasals longer than wide, separated in front, and from the rostral by a pentagonal azygos plate. Frontal narrow, with concave sides, the anterior angles touching the superior preoculars. Superciliary plates convex, subtriangular, and nearly acute in front. Parietals elongate, posteriorly acute and much divaricate. Muzzle quite narrow, eyes directed laterally.

Color above ash-gray, with six or seven longitudinal series of brown spots. Those of the median two or three rows are sometimes united, forming short cross-bars. Those of the inferior series are on the first row of scales and are blacker than the others. Below cream-colored ashen, with irregular black blotches on the anterior part of each scutum. Tail nearly uniform ash above and below, excepting a blackish line along the junction of the scutella. Throat yellow; inferior labials yellow with blackish posterior borders; superior labials less bright yellow with brown posterior and superior borders. Top of head brown, with darker brown markings, as follows: A dark shade in the middle of each parietal; a narrow × opening forwards on the frontal; a longitudinal line on each superciliary, and a transverse waved line across each prefrontal.

Total length, M. .708; do. of rictus oris, .021; do. of tail, .171.

I caught this snake in a net while fishing in the San Francisco river, New Mexico, on the ranch of Mr. H. C. Wilson, which is near the boundary line of Arizona. In its characters it is quite unique, combining the entire anal plate of Eutænia with the dental characters of Regina B. & G., and a third internasal plate, a character rarely met with in serpents. The only North American snake to which it bears any resemblance is *Tropidonotus taxispilotus* Holbr. It is a good swimmer, and is doubtless piscivorous, like other water snakes.

I here take occasion to record my obligations to Mr. H. C. Wilson, without whose aid I should not have had the opportunity

of making the excursion on which I took this snake and other interesting objects.—*E. D. Cope.*

Habits of the Aye-aye.—Little is known of the habits of this creature, as it is a nocturnal animal. Rev. G. A. Shaw sends a few rough notes regarding it to the Zoölogical Society of London, which appears in its Proceedings. He says: "This curious animal (*Chiromys madagascariensis*) has evidently been named from the exclamations of the people who first saw it, and who, upon first sight of anything so peculiar, would naturally utter the usual Malagasy exclamation of surprise, Hay! Hay! And at the present time among the people it is called the Haihày (pronounced Hayehaye)." Native reports are contradictory as to its habits in a wild state, especially as to its food. In confinement it likes bananas and eats small fruits of various native shrubs, as also rice boiled in milk and sweetened with sugar, but meat, larvæ, moths, beetles and eggs it would not touch. "It did not hold its food in its hands as the lemurs which I have had in captivity have done, but merely used its hands to steady it on the bottom of the cage. But whenever it had eaten, although it did not always clean its hands, it invariably drew each of its long claws through its mouth, as though, in the natural state, these had taken a chief part in procuring the food." While some writers state that the haihay is easily tamed and inoffensive, Mr. Shaw's experience taught him that it was "very savage, and when attacking, strikes with its hands, with anything but a slow movement. As might be imagined in a nocturnal animal, its movements in the day time are slow and uncertain, and it may be said to be inoffensive then." A number of superstitious beliefs are connected by the natives with it.

Zoological Notes. — *General.* — MM. P. Regnard and R. Blanchard have recently studied the respiratory capacity of animals of aquatic habits, with results that corroborate those of M. Paul Bert. If the respiratory capacity of the monitor (*Varanus arenarius*) be placed at 5, it is equal to 8.4 in the alligator. Among birds the respiratory capacity of the common fowl is 12, while that of the duck is 18, and among mammals that of the dog is to that of *Phoca vitulina* as 25 is to 37.8. Thus the following is formulated as a law: "An animal accustomed to exist a long period without taking breath will, thanks to the richness of its blood in hemoglobine, take in an extra store of oxygen on which to live.——M. Merejowsky contributes to the Bull. Soc. Zool. de la France the results of recent researches on zoönerythrine and other animal pigments. A list of the species in which that naturalist has noted the presence of zoönerythrine includes several members of each of the following sub-kingdoms and classes: Cœlenterata, Vermes, Bryozoa, Echinodermata, Mollusca, Tunicata, Crustacea and Pisces, in all 117 species. Zoön-

erythrine is usually found in the superficial layer, but in some species it occurs in the muscular tissue. Various phanerogamous and cryptogamous plants also contain it. Numerous other pigments are enumerated. One group of these is characterized by the ease with which they can be transformed into zoönerythrine under the influence of certain chemical or physical conditions, such as elevation to the boiling point, or the addition of a drop of acid, while another group is characterized by the impossibility of transforming them into zoönerythrine.——J. Kollman (Zool. Anzeiger, Oct., 1882) argues in favor of the double nature of the excretory organs of the Craniota. The transverse canals are probably homologous with the segmental organs of annelids, but this does not apply to the unsegmented longitudinal canals, which have a distinct origin and become afterwards connected with the transverse canals.

Fishes.—The fishes of that part of the west coast of Africa comprised between Cape Palmas and Cape Lopez are not yet well known. The most recent addition to our knowledge is the result of the researches of M. Maurice Chaper upon the Gold coast, and consists of thirteen species, four marine and nine fresh-water. Of the latter four species are new, and are described by M. Sauvage in the Bull. de Soc. Zoologique, 1882.——Dr. R. Blanchard has made numerous observations upon the action of the secretion of the pyloric processes of fishes, with a view to ascertain whether they fulfilled in any way the office of a pancreas. His experiments were conducted at Havre upon ten species of fishes: *Alosa finta*, *Merlangus pollachius*, *Merlucius vulgaris*, *Gadus luscus*, *Trachinus draco*, *Trigla pini*, *T. corax*, *T. lineata*, *Trachurus trachurus* and *Zeus faber*, and the invariable result was to the effect that the secreted fluids transforms starch into glucose, and albuminoids into peptones. They are therefore partial representatives of a pancreas, but have no action upon fats.

Reptiles.—The list of the Batrachia and Reptilia of Illinois, prepared by Messrs. N. S. Davis and F. L. Rice, includes seventy-four species of reptiles and thirty-two of batrachians, or nearly one-third of the forms found in the United States. The finding in Northern Illinois of an example of *Siren lacertina* is rather startling.——F. Müller has contributed to the Catalogue of the Basle Museum an account of the distribution in Switzerland of the two species of viper, *Vipera aspis* and *V. berus*. The latter species appears to occupy the eastern and north-eastern portions of the country, while the former is distributed in the west and along the southern frontier.

Birds.—Professor Huxley (Proc. Zoöl. Soc.) has shown that the respiratory apparatus of the Apteryx differs from that of other birds chiefly in the greater size and lesser complexity of the canals, the rudimentary state of the pneumatic sac and the con-

siderable development of the aponeurotic expansions; all peculiarities which approach the reptiles. There is nothing resembling the diaphragm of mammals.

PHYSIOLOGY.[1]

THE NEW CORPUSCLE OF THE BLOOD AND ITS RELATION TO COAGULATION.—It was the view of Alex. Schmidt that the fibrin of clotted blood was a compound formed by the union of two fibrin factors, fibrinoplastin and fibrinogen, under the influence of a third body, fibrin ferment. A number of reasons led to the belief that one or more of the bodies necessary to the formation of fibrin was derived from disintegrated white blood corpuscles. Schmidt taught that fibrinoplastin and fibrin ferment owed their origin to the breaking down of white blood corpuscles or allied forms, while fibrinogen was present in normal circulating blood plasma.

Later, Hammarsten claimed that the whole of the fibrin was derived from fibrinogen alone under the action of the fibrin ferment, and both of these bodies were products of disintegrated leucocytes. Of late years a number of observers have independently described, in accounts which agree more or less perfectly, a morphological element of the blood which differs in its characters from both the white and the red corpuscles.

Bizzozero, whose paper was awarded the prize offered by an Italian scientific society for the most valuable contribution to our knowledge of the causes of the coagulation of the blood, describes this third morphological element of the blood as a colorless disk or lens-shaped body with a diameter equal to one quarter to one half that of a red corpuscle. He states, in opposition to Hayem, that these "plates" are not biconcave and are perfectly destitute of hæmoglobin. Laker states that the disks, while devoid of color, are biconcave in shape, but agrees with Bizzozero that they cannot be considered an intermediate stage in the development of red corpuscles. Laker gives the following method for obtaining a view of the colorless plates: Place a drop of Hayem's preservative fluid on the microscope slide and a drop of blood upon the cover glass and lay the latter upon the slide so that the edges of the two drops shall come into contact; then by means of a slip of filter paper at the side of the cover glass opposite to the drop of preservative fluid, remove as many of the red corpuscles as possible; or, place the two drops upon the slide and lay the cover glass on from the side of the preservative fluid, then drain. The formula for Hayem's preservative liquid is, distilled water 200 parts, sodium chloride 1, soda 5, sublimate 0.5 or osmic acid 1 per cent. Norris, who claims to have described the colorless disks under the name of "invisible corpuscles" as far back as 1878, commonly studies the drop of pure

[1] This department is edited by Professor HENRY SEWALL, of Ann Arbor, Michigan.

blood enclosed between two surfaces, one of which is concave; the latter may be obtained either by using a curved cover glass or by making a depression in the slide. Norris recommends a 5 p. c. solution of sulphate of soda as an excellent preservative for the extremely delicate "invisible corpuscles." The special interest of Bizzozero's work lies in the relation supposed by him to exist between the colorless corpuscles and the coagulation of the blood. This author believes the fibrin to be derived from the disintegration of the colorless disks, and the following are the principal arguments introduced by him in support of this view:

1. Liquids which have a tendency to prevent coagulation preserve also more or less completely the blood plates from destruction; among these liquids are solutions of sodium sulphate, magnesium sulphate, sodium nitrate, strong sodium bicarbonate, dilute sodium carbonate, glycerine, and 0.75 per cent sodium chloride to which some methyl violet has been added.

2. Experiments made upon blood kept within the uninjured blood-vessel, after the manner of Brücke, showed that as long as the blood remained uncoagulated, the blood plates kept their shape, while the rapid coagulation of shed blood was always preceded by a destruction of the plates and the formation of granular masses from them.

3. When a drop or two of blood was whipped with slender threads for about 50–55 seconds, the threads then withdrawn and slightly washed with 0.75 per cent sodium chloride containing methyl violet, and then examined under the microscope in the same liquid, they were found covered with a layer of "plates" together with some white corpuscles. If the whipping was continued longer the layer of plates became a granular mass or was transformed into a film of fibrin. He was able to a certain extent to watch this process, the deposition of the plates, their fusion into a granular mass and the subsequent formation of fibrin, by observing under the microscope a thread placed in a slow current of blood, thus reversing the process of whipping.

4. When to a liquid containing fibrinogen and fibrinoplastin only, some of the colorless blood plates adhering to a thread were added, coagulation followed; the mere presence of a foreign body, as a thread, was shown to have no effect. The coagulation was not owing to the few red corpuscles which it was impossible to wash off the thread, for if large quantities of them alone are added to the mixture of fibrin factors, the clot formed is insignificant or wanting altogether. The clot was not due to the leucocytes adhering to the thread, for when bits of tissue, rich in bodies such as the spleen, lymph glands, red medulla of bone, etc., were added to the "proplastic" liquid, no coagulation resulted, except in the case of the last substance, which sometimes caused a slight coagulum. The conclusion is, that until the white blood corpuscles are shown to be different from the leucocytes,

this experiment must be regarded as conclusive evidence that the plates have the chief rôle in coagulation.

Experiments made upon animals with nucleated red corpuscles, birds and amphibia, showed the presence of a pale nucleated blood plate, differing from the white corpuscles, and which has functions similar to those of the mammalian blood plate already described.—*W. H. Howell.*

Digestion of Meats and Milk.—Jessen has carried out a series of experiments to determine the time necessary for the digestion of equal quantities of different meats and of milk. Three different methods were employed in the investigation: 1. Artificial digestion; 2. Introduction of the meats into the stomach of a living dog by means of a fistula; 3. Upon a healthy man, allowing him to swallow the foods used and ascertaining the time of digestion by means of the stomach pump. The results obtained by the different methods were, on the whole, uniform, as far as the relative time necessary for digestion in each case was concerned, and may be stated as follows: Raw beef and mutton were digested most quickly; for half-boiled beef and raw veal, a longer time is necessary; thoroughly boiled and half-roasted beef, raw pork and sour cow's milk followed next; fresh cow's milk, skimmed milk and goat's milk were still less easily digested; while the longest time was required for thoroughly roasted meats and boiled milk.—*Science.*

Animal Chlorophyll.—Th. W. Engelmann has investigated the function of the coloring matter of the green Vorticella, and comes to the conclusion that it possesess fully the physiological powers of vegetable chlorophyll, causing the evolution of oxygen under the influence of sunlight and probably serving the animal as an organ of assimilation. This view is contradictory to the belief of most of those who have investigated this subject, which is, that chlorophyll found in animal protoplasm is really of vegetable origin maintaining a more or less parasitic residence in it.

PSYCHOLOGY.

The Intelligence of the American Turret Spider.—The Rev. H. C. McCook exhibited nests of *Tarentula arenicola* Scudder, a species of ground spiders of the family Lycosidæ, popularly known as the turret spider. These nests, in natural site, are surmounted by structures which quite closely resemble miniature old-fashioned chimneys, composed of mud and crossed sticks, as seen in the log cabins of pioneer settlers. From half an inch to one inch of the tube projects above ground, while it extends straight downwards twelve or more inches into the earth. The projecting portion or turret is in the form of a pentagon, more or less regular, and is built up of bits of grass, stalks of straw, small twigs, &c., laid across each other at the corners. The upper and

projecting parts have a trimming of silk. Taking its position just inside the watch-tower, the spider leaps out and captures such insects as may come in its way. The speaker has found nests of the species at the base of the Allegheny mountains, near Altoona, and in New Jersey on the sea-shore. In the latter location the animal had availed itself of the building material at hand, by forming the foundation of its watch-tower of little quartz pebbles, sometimes producing a structure of considerable beauty. In this sandy site the tube is preserved intact by a delicate secretion of silk, to which the particles of sand adhere. This secretion scarcely presents the character of a net-lining, but has sufficient consistency to hold aloft a frail cylinder of sand and silk, when the sand is carefully scooped away from the site of the nest.

A nest recently obtained from Vineland, N. J., furnished an interesting illustration of the power of these araneids to intelligently adapt themselves to varying surroundings, and to take advantage of circumstances with which they certainly could not have been previously familiar. In order to preserve the nest, with a view to study the life-history of its occupant, the sod containing the tube had been carefully dug up and the upper and lower openings plugged with cotton. Upon the arrival of the nest in Philadelphia the plug guarding the entrance had been removed, but the other had been forgotten and allowed to remain. The spider, which still inhabited the tube, immediately began removing the cotton at the lower portion and cast some of it out. But, guided apparently by its sense of touch to the knowledge that the soft fibers of the cotton would be an excellent material with which to line its tube, it speedily began putting it to that use, and had soon spread a soft smooth layer over the inner surface and around the opening. The nest in this condition was exhibited, and showed the interior to be padded for about four inches from the summit of the tower. Dr. McCook pointed out the very manifest inference that the spider must, for the first time, have come in contact with such a material as cotton, and had immediately utilized its new experience by substituting the soft fiber for the ordinary silk lining, or rather adding it thereto.—*Proc. Acad. Nat. Sci. Philada., June 19, 1883, p. 131.*

NOTES ON A HAPPY FAMILY.—M. Manouvrier contributes to the Bull. Soc. Zool. de France, an account of the mutual relations of some animals that lived together in a restaurant, under good discipline. The companions were a large watch-dog, a male and female cat, two female hounds, two hares and a pair of pigeons. The last, accustomed to live without molestation, and gifted with too little intelligence to understand the situation, were the tyrants of the place, driving both cats and dogs away from the lighted portion of the floor. The poor cat, awoke from her pleasant sleep in the sun by the cooing and finally by the sundry pecks of

the feeble bird on nose and feet, would often gently give up her place; but would sometimes move too slowly, and, teased beyond endurance, would occasionally bound upon it without hurting it. If the pigeon still continued its attacks, poor puss would discharge her nervous tension by giving four or five bounds into the air and then walk away. One of the hunting dogs, who was very young, would often watch the hares at their play, while the struggle going on in his brain between opposed inclinations was evidenced by a violent trembling of the body. The hares were always somewhat timid with the dogs and cats, yet would administer blows with their feet when the former played too roughly with them.

Gallant Conduct of a Robin.—On a fine Sunday morning in the month of May, my son with another young man were watching a sparrow, *Passer domesticus*, which was building or repairing its nest in a maple tree before the High school of Freehold, N. J. The young men sat on the steps of the school-building. They observed a sparrow-hawk, *Falco sparverius* L., hovering in midair. The Passer perched on the top of a picket but a few feet from them, when the hawk swooped down with great rapidity, seized and carried high in air the poor sparrow before the young men could fairly comprehend the transaction. It was, however, quite otherwise with a robin, *Turdus migratorius*, that had witnessed the deed from his perch in a tree near by. The noble bird lost no time in making pursuit of the marauder. My son says he never saw a robin fly with such speed as did this one. Soon it caught up with the hawk, which it fought desperately, literally pulling out the feathers by mouthfuls, which were easily seen floating in the air. The brave bird must have drawn blood, for every dip of its bill brought out a craven cry from the buccaneer. The robin achieved a complete victory, and the hawk, dropping his booty, made an ignominious retreat. The whilom prey fell a few feet through the air, probably half dead with fright, but regained its senses in time to recover the use of its wings before reaching the ground, when it flew away in a direction prudently the opposite of that taken by the hawk.

As to the conduct of the robin, it surely was magnanimous and courageous to a degree. The bird it rescued was at best an unfriendly pariah. These foreign sparrows, like some other intelligent citizens, as a friend remarked: "Are not overly loving to anything native born." I think the robin showed fine pluck. Had the hawk, on giving up his prey, turned upon his pursuer, the odds would have been fearfully against that brave bird. But the attack was so vigorous that the hawk was completely cowed, and glad to get away by flight. Whether the traditional killer of "cock-robin" experienced the emotion of gratitude to his deliverer is a bit of bird psychology that we cannot get at.—*Samuel Lockwood.*

ANTHROPOLOGY.[1]

INDIAN ARCHÆOLOGY.—The British authorities in India have prosecuted their archæological researches with commendable zeal. In the year 1880 appeared the charming volume, "The Cave Temples of India," by Messrs. Fergusson and Burgess, and we have now to chronicle the appearance of two elegant quartos forming Vols. IV and V of the Archæological Survey of Western India. Volume IV is a report on the Buddhist cave temples and their inscriptions, being part of the result of the fourth, fifth, and sixth seasons' operations of the Archæological Survey of Western India, 1876–1879, supplementary to "The Cave Temples of India." Volume V is a report on the Eleura cave temples and the Brahmanical and Jaina caves in Western India. Both volumes bear the imprint of Trübner & Co., 1883. Volume IV has sixty photolithographic plates and twenty-five wood-cuts; volume V, fifty-one plates and eighteen wood-cuts. The number of rock-cut temples exceeds a thousand, and though by far the greater number of them are found in the Bombay Presidency and immediately adjoining districts, others exist, either singly or in groups, both in Bengal and Madras. The caves are divided among the three principal religions: the oldest and most extensive to the Buddhist, the next in date to the Brahman, and a smaller series to the Jaina. The oldest of all are the simple cells excavated for Buddhist monks during the reign of Asoka (B. C. 263–225) in the granite rocks of Bihar, and the series extends to the Ajanta caves, probably as late as 700 A. D. The Brahmanical caves extend to the tenth century, while the Jaina excavations, commencing at the same time as the Brahmanical, were continued in the rock at Gwalior to the middle of the fifteenth century. All who have written upon this theme have been unable to repress their enthusiasm in the presence of so much patience, skill, and artistic advancement.

Accompanying these *œuvres de luxe* comes another quarto volume in modest binding and without a single illustration, on the Archæological Survey of Southern India. The title reads: "Lists of Antiquarian Remains in the Presidency of Madras. Compiled under the orders of government by Robert Sewell. Vol. I. Madras, Govt. Press, 1882." The volume is the report of an investigation and correspondence respecting all the known sculptures and monumental inscriptions in the Madras Presidency, in order to prepare the way for a detailed survey, and to furnish general information for the guidance of many residents in Southern India who might be interested in the subject. A slight notion of the magnitude of the work may be gathered from the fact that over 3000 villages are mentioned, and 325 pages are devoted to the enumeration of the remains and inscriptions.

[1] Edited by Professor OTIS T. MASON, 1305 Q street, N. W., Washington, D. C.

NOTATION OF KINSHIP.—The number of any one's ancestors is ..... $2^{4,}$ $2^{3,}$ $2^{2,}$ $2^{1,}$ followed by 2^{0} for himself, the binary notation being 10,000, 1000, 100, 10, 1. Every direct ancestor in the *n*th degree admits of being specified by a particular number, consisting of $n + 1$ places. The two parents are 10 and 11, grandparents 100, 101, 110, 111, and so on. Literally the three past generations would stand thus:

Child

f *m*

ff *mf* *fm* *mm*

fff *mff* *fmf* *mmf* *ffm* *mfm* *fmm* *mmm*

Numerically the same series would be:

1

10 11

100 101 110 111

1000 1001 1010 1011 1100 1101 1110 1111

In the ancestry the even numbers mark males, the odd, females. Each term carries on its face every step in the descent. Instead of saying, for instance, B was father's mother of A, we say B was 101 of A. If the father's-father's parents of C were the mother's parents of D, we say the 1000–1 of C are the 110–1 of D. The case might have been one of half blood, say by the father's side, then the 1000 of C would be 110 of D. Translating the binary into common figures, we have:

TABLE OF ANCESTRAL ROOTS.

GRADE OF KINSHIP.	FATHER'S SIDE.	MOTHER'S SIDE.
Child...................	1	
Parents..................	2	3
Grandparents............	4 5	6 7
Great-grandparents.......	8 9 10 11	12 13 14 15

The sex of 1 is unspecified, but in the other lines the odd numbers are for females, the even for males. If n is the register number of any ancestor, the register number of his parents are $2n$ and $2n + 1$. We can then construct or analyze any register number with great facility. As an example of analysis, write down the number and append to it a series of successive halvings so far as the numbers are, or come out even, otherwise subtract 1 before taking their halves. Then write f (= father of) or *m*

(= mother of) as the case may be, below each entry. Let 253 be the number, then we get:

253	126	63	15	7	3	child.
m	*f*	*m*	*m*	*m*	*m*	child.

The foregoing is taken from a contribution to *Nature* by Mr. Francis Galton. The *m* and *f* for *mother of* and *father of* confuse one, the same letters having been recently used in an elaborate paper in the *Anthropological Institute Journal* for *male* and *female.* It is to be hoped that Mr. Galton will continue his study on this point and seek to extend the application of the system to classificatory kinship.

GERMAN ANTHROPOLOGY.—The third and the fourth quarterly parts of *Archiv für Anthropologie*, Vol. XIV, come to us in a single binding. Among the original papers the following are of general interest:

A case of abnormal hairiness in a child. By Dr. H. Ranke.

An alate extension of the skin in a human neck. By O. Kobylinski.

The eye of the Fuegians and the sight of the lower races in comparison with that of cultured races. By Dr. Seggel.

Copper alloys, their description and application among ancient peoples. By Dr. E. Reyer.

Account of Russian literature upon Anthropology, Ethnology, and Travel. By Dr. Ludwig Stieda, pp. 387–90.

Review of Scandinavian literature. By Julia Mestorf, pp. 391–410.

Reviews of the Anthropological literature of America. By Dr. Emil Schmidt, pp. 411–435.

Catalogue of anthropological literature:

I. Pristine history and Archæology. By J. H. Müller, 41 pp.

II. Anatomy. By Ad. Pansch, 5 pp.

III. Ethnology and Travels. By Dr. Albrecht Penck, 90 pp.

IV. Zoölogy. By Dr. Georg Boehm, 13 pp.

Account of the anthropological collection of the Schneckenberg Museums at Frankfurt, A. M. By H. Schaaffhausen, 36 pp.

Account of the anthropological collection of the Grand-Ducal Cabinet, in Alten Schlosse, Darmstadt. By H. Schaaffhausen, 25 pp.

Correspondenz-Blatt, from XIII, No. 9, to XIV, No. 4.

The titles of books and other publications mentioned above are not merely a catalogue of names, but important works are followed by abstracts, many of them of great value. The *Archiv* is *facile princeps* among the journals of anthropology.

THE ORIGIN OF INVENTION.—In February last Colonel F. A. Seely, examiner in the U. S. Patent Office, read a paper before the Washington Anthropological Society on the Origin of Invention. It is well known that one whose daily life is spent among human inventions must acquire a semi-automatic habit of looking at all things in a peculiar manner. For instance, while we search for the rudest form of a machine and follow up its improvements to the perfected form, Colonel Seely would go just the other way,

examine the perfected form and try to understand the machine by a series of eliminations. He first, by way of explaining his method, eliminates the improvements on the steam engine until he gets us back to a savage man blowing through a hollow reed that nature supplied. This was the starting point of invention, a purely human characteristic. The author then applies his method to bows and arrows, stone implements, etc., and is brought to the following conclusion:

"It is clear that neither to Professor Dawkins and Professor Gaudry, nor to Mr. Grant Allen, is it hard to imagine that a creature, inferior to man both in physical and mental structure, may have made such progress in art as to be able to work so difficult a material as flint, and to have developed such wants as to call for the practice of that art. All lose sight of the nature of art and the laws of human progress, and they indicate a conception of art prior to man, but an inability to conceive of man as existing without a certain degree of progress in art. It would seem to them that the first human creature, whatever his origin, must have signalized his advent and perpetuated his memory literally in a

'Monumentum aere perennius,'

by instantly, without preparation or conscious need, chipping out tools of flint. The quotation from Lucretius,

'Arma antiqua manus, ungues, dentes fuere,
Et lapides, et item sylvarum fragmina rami,'

is misapplied by archæologists. *Lapides* does not mean flaked or polished stone any more than *fragmina rami* means dressed timber."

The author traces back of the rudest wrought stone, an age of wood, and other perishable materials, and anterior to that the age without invention.

MICROSCOPY.[1]

RECENT IMPROVEMENTS IN SECTION-CUTTING.—In sectioning objects imbedded in paraffine, the knife is generally fixed, by a clamp, more or less obliquely to the carrier, and the sections almost invariably roll. The rolling of the sections, which is caused by the bevel given to the cutting edge of the knife in sharpening it, besides leading to difficulties of manipulation in the process of mounting, often injures or completely ruins the sections. Many efforts have been made to find some convenient means of preventing the rolling, and very recently successful methods and instruments have been devised to meet the difficulty. In some knives I have found places where the edge was so thin that the bevel appeared wholly wanting. Such portions of the knife usually cut without causing the sections to roll; and this fact might

[1] Edited by Dr. C. O. WHITMAN, Mus. Comparative Zoology, Cambridge, Mass.

lead one to conclude that the entire blade could be made, by proper treatment, to cut in the same way. It was in this direction that I at first hoped to find a remedy against the difficulty in question ; but I have found that when the blade is reduced to the requisite thinness, it lacks the firmness required for uniform sectioning.

In Vol. XVI, p. 782, of this journal, I have given the method used, until quite recently, at the Naples Zoölogical Station for preventing rolling. This method, which consists in holding a needle, spatula or brush lightly over the paraffine during the cutting of each section, is inconvenient and slow, and has already been abandoned for the one described below.

THE SECTION-SMOOTHER[1] DEVISED BY MAYER, ANDRES AND GIESBRECHT.—The section-smoother ("schnittstrecker") is an instrument designed to prevent the rolling of sections ; it is attached to the knife itself, and thus accomplishes its work unaided by the hand.

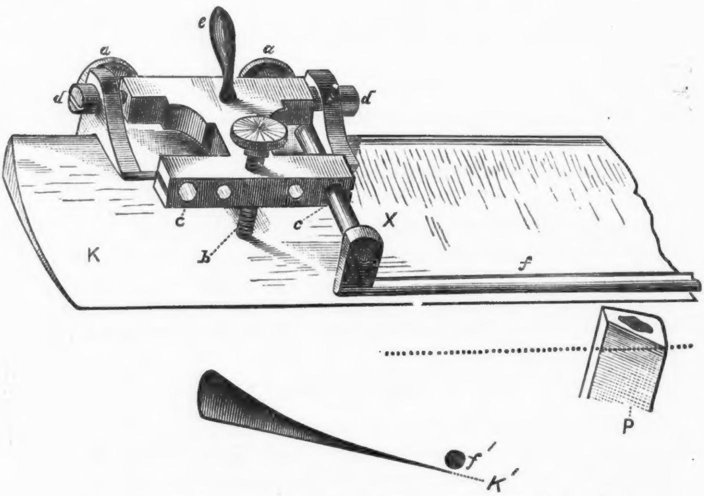


FIG. 1.—Section-smoother. After Mayer, Andres and Giesbrecht.

The accompanying figure represents a portion of the knife, *k*, with the section-smoother attached, and a block of paraffine, *p*. A section of the knife and rod, *f'*, is also given, in order to show the position of the rod above the edge of the knife.

The most important part of the instrument is the cylindrical steel rod, *f*, which is supported in a position exactly parallel to, and close above, the cutting edge of the knife. In this position

[1] "Neuerungen in der Schneidetechnik," in Mittheilungen aus der Zoolog. Station zu Neapel, Vol. IV, p. 429, 1883.

the rod compels the sections to pass between itself and the knife. The parallel position of the rod in the vertical plane is obtained by rotating it about the axis, *x*, which turns in the hole *c* or *c'*; the parallel position in the horizontal plane is reached through the screw *a* and *a'*; and the vertical distance of the rod from the edge of the knife is regulated by the screw, *b*. The entire apparatus is slipped on at the end of the blade, and held fast by two springs that press upon the under surface of the blade. The rod and its holder, which rotates on the axis, *d d*, can be lifted up from the edge of the knife by the aid of the handle, *e*, and turned back far enough to admit of cleaning the rod and the knife. The apparatus includes three interchangeable rods, differing in thickness in adaptation to sections of different sizes.

THE REGISTERING MICROMETER-SCREW.—In the "Microscopy" for the September number of this journal may be found a figure (Fig. 3, p. 996) illustrating the micrometer-screw, and an explanation of its use. In the improved form invented and described by Mayer, Andres and Giesbrecht, an arrangement for regulating its movement has been added. It consists of a spring which, after a given number of divisions of the drum, registers to the ear and finger of the manipulator the number of micromillimeters which the object has been raised. The intervals between the registering clicks can be varied by means of a vernier-like adjustment of the two halves of the drum, so as to equal an entire revolution of the drum, or only $\frac{1}{15}$, $\frac{1}{3}$, $\frac{1}{2}$ of a revolution.

An examination of Fig. 2, which illustrates the new form of the drum, will show how the intervals are regulated. The drum is composed of two symmetrical halves, *a b* and *a' b'*, so closely opposed that the dividing line (dotted in the figure) is scarcely visible. The periphery of each half is composed of two zones of unequal radii. The larger zones, *b* and *b'*, are in apposition, and together form the graduated portion of the drum. Each of the smaller zones are marked with the figures 1, 2, 3 and 15. When the drum is in order for work, it rotates with the screw, which is marked *g g* in the figure above referred to.

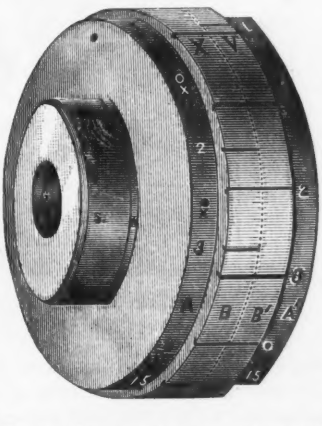


FIG. 2.—Drum of the new micrometer-screw.

The left half of the drum, *a b*, is held in position by the screw, *s*, and may be rotated indepen-

dently of the right half, $a' b'$, or of the screw, $g g$, by the aid of a handle which fits the holes $x x x$.

When the half $a b$ is adjusted to the half $a' b'$, in the manner represented in the figure, the fifteen equal parts into which the zone b is divided exactly correspond to the same number of parts in the zone b', so that the grooves which mark these parts in one zone, become continuous with those of the other zone. Thus adjusted the spring, which rides on the zones $b b'$ with a sharp edge parallel to the grooves, will give fifteen sharp clicks in the course of one rotation of the drum, the click being heard every time the sharp edge falls into coincident grooves. In order to adjust for fifteen clicks, it is only necessary to rotate $a b$ until groove fifteen becomes continuous with groove fifteen of the opposite half ($a' b'$). For one click in one rotation, the grooves 1 1 must be made to coincide; for two clicks the groves 2 2, and for three clicks the grooves 3 3. The intervals between successive clicks may thus be made to correspond to $\frac{1}{1}$, $\frac{1}{2}$, $\frac{1}{3}$ or $\frac{1}{15}$ of a complete rotation of the drum, and the thickness of sections corresponding to these intervals should be respectively .015, .0075, .005, .001^{mm}.

THE NEW OBJECT-HOLDER.—The object-holder which now accompanies the Thoma microtome is an invention of Mayer, Andres

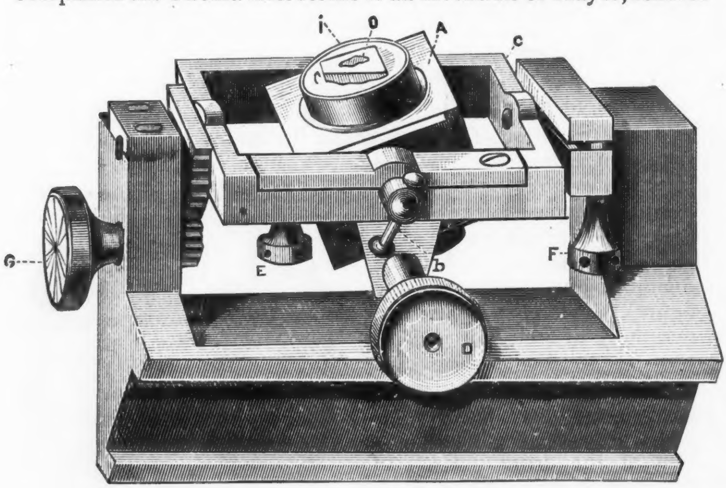


FIG. 3.—The Object-holder and Carrier.

and Giesbrecht, and has been described by them in the place before cited. The object is now movable in all three directions; it is raised or lowered, and turned about the perpendicular axis by free-hand; but in the two other planes it is moved by pinions, so that the plane of section may be altered at pleasure, during the

process of cutting. As seen in Fig. 3, the object, *o*, imbedded in a small piece of paraffine, is attached to a larger mass of paraffine contained in a hollow metallic cylinder. The cylinder, *r*, may be slipped up or down in the cubical block, *a*, and turned around its longer axis by means of a small metallic rod applied in holes near its lower end (holes not seen in figure). The position of the cylinder may be fixed by the handle, *b*, which works like the handle of a vise.

The block, *a*, may be turned about the transverse axis of the frame which holds it, by the pinion *d*, and fixed by the screw *e*, the head of which is provided with holes for the metallic rod.

In the same way the frame itself may be made to turn about its longer axis by means of the pinion *g*, and fixed by the screw *f*.

The chief merit of this holder lies in the fact that the object may be rotated very freely about the two axes of the frame, without at the same time being raised or lowered very much. This latter advantage depends on the fact that the axes of rotation are near the top of the block, *a; i. e.*, as near the object as possible.

The attachment of the object to a cylinder movable in a perpendicular direction, has the great advantage that pieces of more than two centimeters in length may be sectioned. In order to obtain room for pieces of greater length, washers of .5 or 1^{cm} thickness may be placed at first under the knife, and afterwards removed.

An Improvement in the Carriers.—The advantages of having the carriers slide on five points (instead of two even surfaces) between two even planes, have been thoroughly discussed by Thoma (cf. Naturalist, September, p. 993–994). The most recent improvement, according to Mayer, consists in making the so-called "points" of ivory, and the planes, on which the points slide, of an alloy of zinc and copper (Rothguss). The result is, that these parts are no longer exposed to rust, and that the plane surfaces on which the knife-carrier slides are not exposed to injurious friction.

Prices of the Microtome and its Adjuncts.—

The older microtome, consisting of a stand of cast-iron and the two carriers, without the micrometer-screw	$24 00
Same with ivory "points" and new object-holder	27 50
The registering micrometer screw	10 00
Knife for oblique cutting (16^{cm} long) with étui	5 00
Knife for transverse cutting with étui, holder, &c	8 00
Section-smoother	2 25
The complete set, including stand with "planes" of zinc and copper alloy and ivory "points," registering micrometer-screw, the two kinds of knives with étuis, and section-smoother	58 50

This microtome can be obtained from the maker, Rudolph

Jung, 15 Hauptstrasse, Heidelberg, or can be ordered through Geo. A. Smith & Co., 7 Park street, Boston, Mass.

TYPE-METAL BOXES FOR IMBEDDING.—I have before described the type-metal boxes and the method of using them in imbedding,[1] and should now add, what was unknown to me at the time, that the credit of introducing such boxes belongs to Mr. Geo. Dimmock. Mr. Dimmock also used for the same purpose *quotations*, such as are used by printers in filling blank spaces at the beginning and end of chapters. These quotations vary somewhat in size, and are sold at 25 cts. a pound.

Mayer, Andres and Giesbrecht recommend brass instead of type-metal for these boxes, and a wash of thin collodion, where it is desirable, to keep the paraffine in a melted condition for a considerable time, as in imbedding small objects in definite positions. The glass plate forming the base of the box is first wet with glycerine, and then the box is washed with collodion and placed on a water-bath in order to evaporate the ether. In this way a box is obtained in which paraffine can be kept for hours in a fluid condition without escaping between the glass and the metallic pieces. The box is kept on a small water-bath, made for this special purpose, while arranging the object under the dissecting microscope.

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SCIENTIFIC NEWS.

— Dr. F. C. Noll has found a fluid which is very suitable for permanent preparations of delicate Crustacea and their larvæ, preventing their shrinking or becoming too transparent.

It is a mixture of equal volumes of Farrant's medium and Meyer's fluid No. II. It is never cloudy nor entirely dry, although it has such a consistency that air-bubbles scarcely ever occur. The preparation is sealed with asphalte or some other varnish. In order to prevent the cracks arising in the asphalte varnish, it is better, after a time, to pass over it a layer of transparent shellac.

Hydroids, small medusæ and other cœlenterates which have been hardened in alcohol and then stained may, the author says, be splendidly preserved in the above fluid.

— Mr. W. S. Kent has found potassic iodide useful in preserving Infusoria. It acts in a manner almost identical with osmic acid, and in some instances even more efficiently. The medium possesses the additional advantage of yielding no deleterious exhalations, which have to be carefully guarded against in the use of osmic acid. The formula for preparation is as follows: Prepare a saturated solution of potassic iodide in distilled water; saturate this solution with iodine, filter, and dilute to a

[1] AMERICAN NATURALIST, Oct., 1882, p. 781.

brown sherry color. A very small portion only of the fluid is to be added to that containing the Infusoria.

— Among the discoveries last summer of the U. S. Fish Commission is that of a deep-sea fish, closely allied to the very strange Eurypharynx dredged last year at the bottom of the Mediterranean sea. Drs. Gill and Ryder have studied the anatomy of this form, of which five specimens occurred, and have found that it presents so many peculiar features as to entitle it to form the type of a new order. Ten new genera and seventeen new species of fishes were collected in addition, besides new mollusks and worms.

— The Bulletin of the Nuttall Ornithological Club will hereafter be the organ of the American Ornithologists' Union. It will continue to be edited by Mr. J. A. Allen and his associates. This journal will doubtless be, as heretofore, the meeting ground of our ornithologists, and ably represent American workers in this field.

— Professor Zittel, of Munich, while in this country visited the collections of Professor Cope and the museums at Princeton and Yale, and was much impressed with their extent and importance.

— We regret to announce the suspension of the *Canadian Naturalist*, which the publishers announced in the last number issued, which was Vol. x, No. 8.

— Another prominent figure in the scientific world, the illustrious palæontologist, Joachim Barrande, died at Prague, in October, in his 84th year. He was the leading invertebrate palæontologist of Europe, and indeed of the world; his series of twenty-two large volumes, richly illustrated and elaborately worked out, will be a monument of his genius and industry. In 1872 we visited the illustrious savant, and were greatly impressed by his wonderfully fine series of fossils, especially Brachiopods, illustrating the variation of species. His interesting and very complete series of trilobites, from those evidently freshly hatched up to the adult forms, and his elaborate descriptions and figures of them would alone have made him famous. His cordial greeting, noble presence, affable and yet distinguished manner and genuine modesty, won all hearts. Barrande was an interesting, indeed a romantic character, and his name will go down among the heroes and martyrs of science.

He was early in life appointed tutor to the young Duc de Bordeau. So strongly did he identify himself with the royal family of France, that when Charles X. abdicated, Barrande accompanied his royal master and friend to Prague, where he remained until his death, occasionally visiting his native land. So strong was his attachment to the legitimist party that he declined a nomination as corresponding member of the French Academy, though receiving honors from the leading scientific societies on both con-

tinents. His work was done in Bohemia, and his collections filled to overflowing the spacious apartments of his mansion in Prague, where he lived simply and unostentatiously, devoting his fortune to the preparation of the plates and text of his works, which he distributed with a princely hand. He belonged in every sense to the old régime. Faithful to the memory and interests of his royal master and to monarchist principles, he was inflexible in his adherence to Cuvierian ideas in biology, in his opposition to transmutation views, though his own striking series of intermediate fossil forms, in other hands, will bear another interpretation than he gave to them; but to whoever this task may fall, he could not discuss their relations to theories of descent with more gentle, suave firmness and less appearance of dogmatism than Barrande showed in his opposition to the newer views. One more link which bound the old and new school in biological science has died in the fullness of years and honors.

— Professor Oswald Heer died at Zurich, Sept. 27. He was born in 1809 near St. Gallen; in 1834 he became a privatdocent for botany and entomology in the University of Zurich, where in 1836 he was appointed professor and director of the botanic garden. Since the year 1853 his continuous series of researches in fossil plants have made his name famous. His works on the fossil plants of Greenland and Spitzbergen were notable, also his extended work and papers on fossil insects. His best known book, The Primeval World of Switzerland, in two volumes, was translated into English. It will always occupy an important place in a scientific library.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Biological Society of Washington, Oct. 19.—Papers were read by Dr. Thomas Gill on the ichthyological results of the explorations of the U. S. Fish Commission steamer *Albatross* in 1883; by Dr. C. A. White on the character and function of the epiglottis of the bull snake (Pityophis); by Professor Lester F. Ward on an interesting botanical relic of the District of Columbia, and by Dr. C. V. Riley on manna in the United States.

Nov. 2.—Communications were read by Dr. George M. Sternberg, U.S.A., on Micrococci; by Dr. E. M. Schaeffer on further remarks on Manna, with exhibition of specimens; by Dr. T. H. Bean on arrested asymmetry in a flounder, with exhibition of specimens, and by Professor Lester F. Ward on Mesozoic dicotyledons.

New York Academy of Sciences, Oct. 15.—The meetings are now held in the new building of Columbia College, 49th street and Madison avenue. The following communications were announced: On the strata of indurated shales between Bergen hill

and the Palisades, N. J., by Mr. Nelson H. Darton; The Trenton (N. J.) gravels and their contained implements, as bearing on the antiquity of man, by Professor Daniel S. Martin.

Oct. 22.—Observations made during the past summer were expected from several members, including Notes on the Copper-mining region of Lake Superior, by Dr. N. L. Britton, and reports by others upon points of interest at the Minneapolis meeting of the American Association for the Advancement of Science.

Oct. 29.—The following paper was announced: The relative soil-exhaustion by the sugar-cane crop, by Dr. A. R. Ledoux; Mr. George F. Kunz exhibited some interesting minerals.

Boston Society of Natural History, Oct 17.—Dr. C. S. Minot discussed the histology of the skin of insects, and Mr. W. O. Crosby spoke of the "Purgatory" in Sutton, Mass.

Academy of Natural Sciences, Philadelphia, May 24.—In answer to Professor Heilprin, Professor Lesley said that the geological world was by no means unanimous with respect to glaciation. No one could say that the movement of ice was from one center, or that that center was in the far north. The Alps had no center of glaciation. There was no foundation in fact for Dana's theory of the relations between continents and oceans. Professor Heilprin replied that the Alps themselves were a center of glaciation.

June 1.—Dr. Leidy spoke of a human bone found in a ravine at Natchez along with bones of Mastodon and Megalonyx. As there are Indian graves near, it was quite possible that the human bone, which was lowest, may have been washed from the soil at the top of the cliff, while the mammals came from a lower position. Yet if the bone had not been human, no one would have thought of such a solution, and the Natchez loam was not older than the alluvium of the Somme, in which human implements have been found with bones of the mammoth.. If proof of contemporaneity were forthcoming, it would indicate the existence of man in North America a thousand centuries ago. Professor Cope detailed the results of two days' fishing in the Batsto river, N. J. The fauna of the region is Carolinian. Twelve species of fishes were obtained, seven of which were confined to the Carolinian fauna, and six to New Jersey and Delaware.

June 7.—Miss Foulke described the artificial reproduction of Actinosphærium. If broken up, the protoplasm of this rhizopod gathers into globular masses, each of which develops into an Actinosphærium. While the natural method of reproduction requires seven to fourteen days, the artificial needs but one or two days. The Rev. Dr. McCook spoke of the habits of *Mygale hentzii* in captivity. In the winter it was inactive but not quite torpid. It dug, and made the earth scratched up by its palps

and anterior legs into soft balls with a liquid from its mandibles, but it made no nest. The molting of another species of Mygale was described. The skin broke along the middle line of the body, and the legs were pulled out by spasmodic efforts, while the spider lay on its back or side. The insect had great difficulty in freeing the limbs of the other side, and broke off two in the attempt, a result which shows that not all the maimed spiders found are so from the attacks of enemies. A large black spider from San Diego, said to be very venomous, and to be in the habit of collecting the cocoons of other individuals of the same species, was exhibited, also a new form of Argiope, for which the name *argentiola* was proposed. Professor Heilprin called attention to Dr. Dahl's opinions respecting the organ of hearing in spiders, and Dr. McCook remarked that he had never been able to convince himself that spiders have the faculty of hearing, and would require further information before he would adopt Dr. Dahl's conclusions as to its residence in the sensory hairs on the legs.

June 14.—A report on the habits and manners of the English sparrow was presented by Mr. T. G. Gentry in answer to a note of enquiry from the Concordville Farmers' Club. Professor Cope stated that several species of invertebrates from the Laramie beds of Dakota had recently been determined by Dr. White to be of the Miocene period, although the evidence of the vertebrates is still in favor of the Cretaceous age of the beds. Some fossil fishes had been found in the beds of shale lying conformably with the Laramie beds. On stratigraphical evidence these beds seemed to belong to the horizon of the Green River shales, but the remains of fishes are not closely allied to those found in the latter beds. A genus named by the speaker Plioplarchus is quite closely related to forms now existing. There was no evidence that the land fauna of the Laramie beds was Cretaceous, and the marine fauna Tertiary. The formation containing the Cernaysienne fauna in France was believed to be nearest in geological age to the Laramie. As the age of the American formation was first determined, the name should be applied to the French deposits. Professor Heilprin maintained the Eocene age of the Laramie. The beds of Maryland and Eastern Virginia contain forms near to those of the lowest English and French Tertiary, and have extensive beds of lignite similar to those of the Laramie. Professor Allen spoke of the distribution of the cutaneous nerves in mammals. The position of conspicuous tufts of hair was accompanied by an increased development of cutaneous nerves, though the relation was not so definite as in birds. Mr. Ashburner stated that the Allegheny oil sands of New York were of the same horizon as the Bradford sands of Pennsylvania, so that it would be useless to sink wells in the intervening tract. Investigations extended into Livingston, Steu-

ben and Wyoming counties, N. Y., established the belief that these sands belonged to the Lower Chemung. The oil in Pennsylvania never reaches the reservoirs from above, but principally from below, though some of the material was formed from plants contained in the beds themselves. Mr. B. S. Lyman, late chief of the Geol. Survey of Japan, stated his belief that oil always originates in the sand where it is found.

June. 21.—Professor Cope gave an account of the fossil fishes from the Idaho and Oregon lake basins. Twenty-two species were now known from Idaho, all distinct from those found in the Oregon basin, and distinct from existing species, though, with two exceptions, they belonged to existing genera. Among these fishes was a member of the Cobitidæ, a family not now represented in North America. The name of Idaho lake and Idaho deposits was proposed for the Pliocene beds of Idaho. No remains of mammals and very few of any vertebrates but fishes were found in the Idaho beds, though the Oregon deposits are full of bird remains. The Rev. Dr. McCook exhibited a nest of *Tarentula arenicola*.

Aug. 31.—Mr. Meehan, recently returned from a trip to Alaska, stated his conclusion, from the relations of ancient forests of *Abies sitkensis*, and other evergreens, to the drift and superimposed younger forests, that the destruction of the former, the covering of their site with hundreds of feet of drift, and the subsequent exposure of their remains, were all the work of a few hundred years.

Sept. 6.—Mr. Meehan spoke of the abundant exudation from the cones of *Abies sitkensis*, and expressed his belief that honey-dew was in most cases an exudation from the flowers and leaves of plants. Sachs had suggested that its function in the arbor vitæ, was to catch the wind-blown pollen, but this could not be the case in plants of other classes that also produce it. The Rev. Dr. McCook remarked that the honey-dew of aphides was an excretion, as the drop always appeared at the anus. That the source of the honey was vegetable, he had proved in the case of the honey-ant of Colorado, which collects the liquid from the galls of the scrub oak.

Sept. 13.—Mr. Meehan called attention to the flowers of *Centaurea americana*, a native of Texas. If the point of the united stamens be touched, the pollen will overflow and the pistil rises above the stamen-tube. If now the pistil be touched, the entire floret bends to the side or makes a circular motion, and sometimes the motion is communicated to other florets. The motion is only observed when the pollen is present.

Sept. 20.—Mr. Meehan referred to the remarks of Dr. Horn, at one of the summer meetings, respecting a species of grass which yields so abundant a supply of sugar that the natives collect it by brushing the hands over it. The plant is a Carex, and

is called Ce-we-be by the Indians. The age of the great examples of *Sequoia gigantea* was proved by the verticels of the branches as well as by the rings of wood, to be at least 2000 years. Young Sequoias of this species are abundant at 8000 feet, though scarce below, indicating that at this elevation the species was probably in its natural condition.

American Philosophical Society, April 6, 1883.—Mr. Davis read a paper on the conversion of chlorine into hydrochloric acid, as observed in the deposition of gold from its solution by charcoal. Professor W. E. Claypole communicated two papers entitled, "On the Kingsmill white sandstone," and "Note on a large fish-plate from the Upper Chemung (?) beds of Northern Pennsylvania." The plate belongs to Pterichthys or some related genus, and the species is provisionally named *Pterichthys rugosus.* Mr. Lockington read a paper entitled, "The role of parasitic protophytes; are they the primary or the secondary cause of zymotic diseases."

National Academy of Sciences, New Haven, Nov. 13–16.—The meetings, which extended through four days, were well attended, a large proportion of the members being present. The following papers were read:

1. Upon the formation of a deaf variety of the human race. A. Graham Bell.
2. On the Solar Eclipse of May 6, 1883. Reports by C. A. Young, E. S. Holden and C. S. Hastings.
3. Notes on the Mass of Saturn. A. Hall.
4. The Animikie rocks of Lake Superior. T. Sterry Hunt.
5. On some new primary cleavage forms of albuminous matter. R. H. Chittenden. (By invitation.)
6. On the use of the word "Light" in Physics. S. Newcomb.
7. On the subsidence of particles in liquids. W. H. Brewer.
8. On a new photograph of the Solar Spectrum. H. A. Rowland.
9. On the theory of errors of observation and probable results. S. Newcomb.
10. On the stratified drift or terrace formation of the New Haven region, including its kettle holes and deserted river channels. J. D. Dana.
11. Preliminary notice of phospho-vanadates, arsenio-vanadates and antimonio-vanadates. Wolcott Gibbs.
12. On the probable existence of new acids of phosphorus. Wolcott Gibbs.
13. Notes on the mineralogy and lithology of the Bodie mining district of California B. Silliman.
14. On the ancient glaciation of North America. J. S. Newberry.
15. Marriage institutions in tribal society. J. W. Powell.
16. Atmospheric absorption. S. P. Langley.
17. Note upon the physical aspects of the higher members of the Chemung group and the development and distribution of the fossil genera Ptychopteria and Leptodesma, preceded by a review of the Pectenidæ and Aviculidæ of the Devonian system. James Hall.
18. Personality in the measures of Venus's diameter as derived during transit across the sun. O. T. Sherman. (By invitation.)
19. The reduction of barometric observations to sea-level. Elias Loomis.

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